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ABSTRACT

This Heating, Refrigeration, and Air Conditioning course is comprised of eleven individualized units: (1) Refrigeration Tools, Materials, and Refrigerant: (2) Basic Heating and Air Conditioning: (3) Sealed System Repairs: (4) Basic Refrigeration Systems: (5) Compression Systems and Compressors: (6) Refrigeration Controls: (7) Electric Circuit Controls: (8) Domestic Equipment: (9) Walk-In Coolers: (10) Other Air Conditioning Systems: and (11) Equipment Installations. Each unit consists of Learning Activity Packages (LAP) that provide specific information for completion of a learning activity. Each LAP is comprised of the following parts: objective, evaluation procedure, resources, procedure, supplemental sheets, study guide, and a LAP test with answers. The course is preceded by a pretest which is designed to direct the student to units and performance activities. (LRA)

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ED197161

MOUNTAIN PLAINS LEARNING EXPERIENCE GUIDE:
Heating, Refrigeration, & Air Conditioning.

CE 027 791

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**Family
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COURSE TEST: HEATING, REFRIGERATION AND AIR CONDITIONING

75.02.01.00

1. What is used to measure vacuum and pressure?

   a. relief gauge.
   b. compound gauge.
   c. pressure gauge.
   d. device gauge.

2. What type of wrenches are used on refrigeration lines?

   a. flair nut.
   b. long nose pliers.
   c. pliers.
   d. water pump pliers.

3. What is used to close off a tubing end before soldering?

   a. vice grip.
   b. hammer and chisel.
   c. pinch of tubing.
   d. crimp of tubing.

4. Using a twister tip what do you do with the regulator?

   a. set for 6½ pounds.
   b. turn all the way up.
   c. turn all the way down.
   d. set for 12 pounds.

5. When done with torch and tip make sure:

   a. the tank is turned off and hose is bled.
   b. turn up tank and turn down regulator.
   c. turn regulator off and bleed hose.
   d. change the tip.

6. What is the simplest leak detector to use?

   a. electronic leak detector.
   b. bubble solution.
   c. halite torch.
   d. absorption detector.

75.02.01.00 (continued)

7. Is it safe to check for leaks on high side with unit running?

   a. yes.
   b. no.
   c. sometimes.
   d. only on central air.

8. Why do you check around bottom of joint for leak?

   a. leaks accure on bottom.
   b. easier to check bottom.
   c. refrigerant is heavier and air tends to fall.
   d. solder flows poorly at bottom of joint.

9. Why should you change oil in a compressor periodically?

   a. oil becomes rusty.
   b. oil will plug compressor.
   c. oil turns dark black.
   d. oil becomes contaminated.

10. How long should a vacuum be pulled on a system?

   a. 3 hours.
   b. 7 hours.
   c. depends on a wet or dry system.
   d. 1½ hours.

11. Name two (2) ways of checking a vacuum:

   a. with a manometer and set of gauges.
   b. with a manometer and micron gauge.
   c. with a micron gauge and maniforld set.
   d. with a static gauge and manometer.

12. What is used with a vacuum pump to see if you have a tight system?

   a. high vacuum manifold set.
   b. low vacuum manifold set.
   c. static pressure gauge.
   d. system analyzer.

13. Why must you be careful when charging a system to isolate the vacuum pump?

   a. refrigerant can damage pump.
   b. vacuum pump can suck oil out.
   c. may damage manifold set.
   d. may rupture a hose.

75.02.01.00 (continued)

14. How is a vacuum measured?

    a. pounds per square inch.
    b. in inches of mercury.
    c. in feet of mercury.
    d. in BTU's.

15. If you open the bottom valve you will get?

    a. liquid.
    b. gas.
    c. solids.
    d. neither.

16. If you can not get a complete charge in a system, what do you use to force the rest of the refrigerant in with?

    a. a vacuum pump.
    b. a high pressure pump.
    c. a refrigerant expansion tool.
    d. plug in a heater to build up pressure.

17. Name 2 types of refrigerant used in a charging cylinder:

    a. refrigerant 709 and 803.
    b. R 12 and R 22.
    c. R 621 and R 704.
    d. R 14 and R 29.

18. Viscosity is time in seconds it takes for a definite quantity of oil to flow through?

    a. 100 degrees fahrenheit.
    b. 100 degrees centigrade.
    c. 70 degrees fahrenheit.
    d. 211 degrees fahrenheit.

19. Can a person use carbon tetrochloride for cleaning?

    a. yes.
    b. no.
    c. only on condensors.
    d. only on vaporators.

20. What are gaskets used for?

    a. to hold joints together.
    b. to act as a cushion.
    c. seal joints between assembled parts.
    d. to prevent viberation.

75.02.01.00 (continued)

21. What color can does refrigerant R-22 come in?

a. white.
b. green.
c. blue.
d. orange.

22. Refrigerant coming from service cylinder in a normal position comes out as:

a. liquid.
b. gas.
c. combination.
d. none of the above.

23. When you invert a refrigerant cylinder, refrigerant comes out as:

a. liquid.
b. gas.
c. combination.
d. low pressure.

24. What do you first check on a service call?

a. power cord.
b. if cooling.
c. customer complaint.
d. refrigerant level.

25. Why are inventory reports important?

a. to check and see if employee is honest.
b. to keep inventory up to date.
c. to separate good from bad parts.
d. avoid tax problems.

26. Why are trucks equipped with CB radios?

a. so the driver can have someone to talk with.
b. for emergencies only.
c. for rerouting.
d. makes it easier to find directions.

27. What does an employer look for in an employee?

a. someone that makes a lot of money.
b. someone that knows refrigeration.
c. minority.
d. someone good and punctual.

75.02.01.00 (continued)

28. What does an employee expect from his employer?

a. lots of money.
b. good medical and dental benefits.
c. appreciation and chance to advance.
d. paid sick pay.

29. What does a customer expect from a company?

a. honest service and fair prices.
b. fast service.
c. cheap prices.
d. get the shaft.

30. Why do you want to work?

a. to make money.
b. to feed 6 kids and wife.
c. to keep up with the Jones's.
d. self satisfaction and accomplishment.

75.02.02.00

31. How do electrons move?

a. slow.
b. fast.
c. negative to positive.
d. positive to negative.

32. What is the purpose of a fuse?

a. protects fuse holder.
b. protects wiring equipment.
c. protects wiring and components.
d. protects from wind damage.

33. How do you check a fuse to see if it is good?

a. with amp meter.
b. with volt meter.
c. with ohm meter.
d. with a capacitor analyzer.

34. What is a step-down transformer?

a. lowers voltage.
b. raises voltage.
c. triples voltage.
d. sets lower in bracket.

75.02.02.00 (continued)

35. What is the first thing to do when checking resistance?

    a. turn control knob on.
    b. check voltage scale.
    c. zero meter.
    d. check battery pack.

36. How is an ammeter used?

    a. check amps.
    b. resistance.
    c. volts.
    d. weight.

37. What are the main components of a thermostat?

    a. thermometer, dial and switches.
    b. thermometer, dial and wire.
    c. wier, dial and switches.
    d. screws, wire and dial.

38. What is the delay in delivering air at the proper temperature called?

    a. start up time.
    b. heat up time.
    c. thermal inertia.
    d. lag time.

39. Is the heat anticipator in most thermostats adjustable?

    a. sometimes.
    b. all the time.
    c. never.
    d. most of the time.

40. Heating is a form of?

    a. force.
    b. energy.
    c. fuel.
    d. power.

41. What three (3) things must be present in order to have a flame?

    a. fuel, heat, oxygen.
    b. heat, oxygen, water.
    c. fueld, heat, propane.
    d. blower, heat exchange, and fuel.

75.02.02.00 (continued)

42. How many cubic feet of air does it take to produce 1000 BTU's of heat?

   a. 12 cubic feet of air.
   b. 7 cubic feet of air.
   c. 10 cubic feet of air.
   d. 20 cubic feet of air.

43. What percent of the furnace is used to heat the house?

   a. 90%
   b. 80%
   c. 75%
   d. 95%

44. What is the purpose of the heating exchanger?

   a. separate the hot from the cold.
   b. transfer heat, conduction and radiation.
   c. remove unwanted heat.
   d. exchange heat from dirty air to particles/

45. Name the two (2) basic types of blowers:

   a. high and low speed.
   b. forward and reverse.
   c. direct drive and belt drive.
   d. centrifugal receparating.

46. A limit control is?

   a. safety device.
   b. speed control.
   c. safety valve.
   d. a gas pressure valve.

47. How do you change speed on the blower, on a belt drive system?

   a. get a bigger squirrel cage.
   b. adjust the variable speed pulley.
   c. turn the motor around.
   d. tighten the belt.

48. How is primary air adjusted?

   a. with a damper.
   b. draft diverter.
   c. shuttle.
   d. squirrel cage.

75.02.02.00 (continued)

49. What is the purpose of a crosslighter?

a. light burners at same time.
b. divert pilot light.
c. relight pilot.
d. cross over thermocouple.

50. What type of fuel oil is used in most domestic oil burners?

a. number 4 fuel oil.
b. number 3 fuel oil.
c. number 2 fuel oil.
d. number 10 fuel oil.

51. In an oil burner system, what is used to determine whether or not ignition has been accomplished?

a. a flame detector.
b. a noise detector.
c. a safety limit switch.
d. a fan switch.

52. What does a fuel nozzle do?

a. atomize, give fuel delivery, and form a pattern.
b. atomize, give fuel delivery, and heat the fuel.
c. heat the fuel, give delivery, and pressurize the fuel.
d. heat the fuel, clean the fuel, and vaporize the fuel.

53. At what temperature is thermal fuse set to open?

a. 600 to 610 degrees.
b. 300 to 310 degrees.
c. 200 to 210 degrees.
d. 350 to 360 degrees.

54. When does the fan come on in an electric furnace?

a. slightly ahead or at the same time as the first element.
b. 30 seconds after the first element has started to heat up.
c. 2 minutes before the heating element comes on.
d. 3 minutes after the element has come on.

55. What does an air conditioner do besides remove heat?

a. humidity.
b. dehumidify.
c. clean the air.
d. remove smoke.

75.02.02.00 (continued)

56. Can laden heat be measured with a thermometer?

a. only on days with heavy humidity.
b. no.
c. yes, at any time.
d. only with a Taylor thermometer.

57. What takes place during a change of state?

a. a substance goes from liquid to solid.
b b. a substance gets hotter.
c. a substance gets cooler.
d. nothing happens.

58. What do you use to measure sensible heat?

a. hydrometer.
b. a thermometer.
c. a heat sensing gauge.
d. a barometer.

59. Why is R 22 used instead of R 12 in air conditioning systems?

a. it has a much higher laden heat of evaporation.
b. it costs less.
c. it's safer to use.
d. it isn't affected by pressure.

60. Can you use the temperature of refrigerant to find the pressure at which the refrigerant is at?

a. yes, your pressure corresponds to your temperature.
b. no.
c. only when using refrigerant 22.
d. only when using refrigerant 12.

61. What is it called when a system is shut off and the refrigerant condenses into a liquid and returns to the compressor?

a. migration.
b. frost back.
c. flood back.
d. low pressure accumulation.

62. Name three types of evaporator coils used in a central air conditioner:

a. flat coil, A coil and slant coil.
b. flat coil, slant coil and round coil.
c. round coil, square coil and A coil.
d. A coil, slant coil and reverse coil.

75.02.02.00 (continued)

63. How do you measure super heat?

   a. with an electronic super heat thermometer.
   b. by measuring the temperature of the inlet and outlet of the evaporator.
   c. by measuring across the condenser and the evaporator.
   d. by using a super heat thermal gauge.

64. What is a split system central air conditioner?

   a. when the evaporator is split in two sections.
   b. when the condenser is split in two sections.
   c. when the evaporator is housed in one cabinet and the condenser is housed in another cabinet.
   d. when the condenser sits on top of the evaporator.

65. Where would an oil trap be located?

   a. in the suction line.
   b. in the liquid line.
   c. in the high pressure release line.
   d. in the low pressure release line.

75.02.03.00

66. Why is it important to clean metal before flexing and silver soldering?

   a. the silver solder won't dull.
   b. so the flux can be applied easier.
   c. so you have a good leak proof joint.
   d. clean metal heats faster.

67. How do you cut a cap tube?

   a. with a hammer and chisel.
   b. with a wire cutter.
   c. with a tubing cutter.
   d. with a file.

68. How can you tell when the correct silver brazing temperature is raised?

   a. the flux becomes clean and transparent.
   b. the flux becomes brown and dull colored.
   c. the flux becomes blue.
   d. the flux begins to bubble.

69. What do you use to discharge refrigerant gas to the outside air?

   a. a coil hose.
   b. a purging hose.
   c. an evacuating hose.
   d. a restriction hose.

75.02.03.00 (continued)

70. What must you place on most domestic refrigerators before you can evacuate a system?

a. pressure release valve.
b. over load valve.
c. process valve.
d. Tap-a-can valve.

71. When changing a burnt out compressor before charging and installing a dryer, what should be done to the system?

a. flush it out with a warm soapy solution.
b. flush it out with some diesel fuel.
c. flush it out with some refrigerant.
d. flush it out with calcium chloride.

72. What do you use to evacuate a system?

a. low pressure pump.
b. high vacuum pump.
c. a filter dryer.
d. an air compressor.

73. Which stub coming off the compressor is usually the largest?

a. oil cooler line.
b. first discharge line.
c. second discharge line.
d. suction line.

74. What must be done when a compressor is changed?

a. condenser removed.
b. accumulator added.
c. replace dryer.
d. put on new support mounts.

75. When replacing a dryer, what should be done so you don't ruin it?

a. wrap a cold wet rag around it.
b. make sure it is in a vertical position.
c. make sure it is in a horizontal position.
d. epoxy it on.

76. When replacing a condenser on a domestic system, would you:

a. epoxy it on.
b. flare it on.
c. silver solder it on.
d. weld it on.

75.02.03.00 (continued)

77. When installing a suction line filter, why do they have process valves on each side of the filter?

    a. to take temperature drops across the filter.
    b. to take pressure drops across the filter.
    c. to evacuate the filter.
    d. to charge the filter.

78. What is the purpose of the oil separator?

    a. return oil to compressor
    b. separate moisture from the oil.
    c. clean the oil.
    d. keep proper amount of oil in the system.

75.02.04.00

79. Are ice refrigeration systems still used?

    a. no.
    b. only at the north pole.
    c. both at the north and south pole.
    d. yes, they are still used in various applications.

80. An ice refrigerator has to have what qualities?

    a. large area.
    b. small area.
    c. be well insulated.
    d. water resistant.

81. What is the average range of temperature in an ice refrigerator.

    a. between 35 and 45 degrees.
    b. between 40 and 50 degrees.
    c. between 50 and 60 degrees.
    d. between 25 and 30 degrees Fahrenheit.

82. What happens when a fluid evaporates?

    a. heat is absorbed.
    b. heat is lost.
    c. cold is absorbed.
    d. cold is lost.

83. What keeps a desert water bag cool?

    a. rapid evaporation.
    b. it gets cold on the desert at night.
    c. the water keeps it cold.
    d. the bag gets just as warm as anything else in the desert.

75.02.04.00 (continued)

84. Why is it not a good idea for the desert water bag to become warm?

   a. because warm water will make you sick.
   b. because the water will evaporate.
   c. because warm water creates a calcium residue on the liner of the bag.
   d. desert water bags do not become warm if filled with water.

85. What are the four (4) main parts in a compression system?

   a. compressor, condenser, evaporator, metering device.
   b. high side switch, evaporator, condenser, compressor.
   c. compressor, evaporator, condenser, low side switch.
   d. AXV, TXV, cap tube, compressor.

86. Where is the metering device located in a compression system?

   a. between the compressor and evaporator.
   b. between the evaporator and condenser.
   c. between the condenser and compressor.
   d. between heat exchanger and thermal element.

87. Where is the low pressure area in a compression system?

   a. condenser.
   b. evaporator.
   c. compressor.
   d. liquid receiver.

88. What happens to the amonia gas in the condenser?

   a. it turns to a vapor.
   b. it is cooled and condensed to a liquid.
   c. it is heated and condensed to a liquid.
   d. it is heated and condensed to a vapor.

89. What is the most popular fuel used in an intermittent absorption system?

   a. gasoline.
   b. diesel.
   c. LP
   d. kerosene.

90. What is the approximate pressure of a continuous cycle absorption system?

   a. 200 lbs. per square inch.
   b. 176 lbs. per square inch.
   c. 380 lbs. per square inch.
   d. 125 lbs. per square inch.

75.02.04.00 (continued)

91. What kind of experiments were performed by Michael Faraday?

   a. to liquify gases.
   b. that freon is heavier than air.
   c. that amonia could be heated.
   d. that amonia was a poor refrigerant.

92. What is an important part of installation in a continuous cycle absorption system?

   a. it has to be leveled carefully.
   b. it has to be free of vibrations.
   c. it cannot be in contact with any walls.
   d. it has to be on a 5 degree angle.

93. How is the compressor driver?

   a. by electric motor.
   b. off the drive shaft.
   c. off the front of the car engine.
   d. by a separate gas engine.

94. What is used to control the flow of refrigerant in the system?

   a. a capillary tube.
   b. a suction throttling valve.
   c. an automatic expansion valve.
   d. a pressure release valve.

95. At what speed does the compressor run?

   a. 2800 rpm.
   b. 3600 rpm.
   c. 1800 rpm.
   d. it depends on how fast the car engine is running.

96. Are all car air conditioners made by the same company?

   a. yes.
   b. no, they are made by several companies.
   c. they are made by Frigidaire and York.
   d. they are imported from Europe.

97. How does a load factor differ in a car air conditioner compared to a house air conditioner?

   a. there is no difference.
   b. it is just about the same.
   c. the load in a car air conditioner changes drastically.
   d. the load factor in a house changes drastically.

75.02.04.00 (continued)

98. Where do you find the amount of charge a system will hold?

    a. it is stamped on the door frame of the car.
    b. you just charge them all according to the sight glass.
    c. you charge the system until it frosts back.
    d. there is usually a metal plate with the charge stamped on the compressor.

75.02.05.00

99. What four major components of a refrigeration system are used in a compression cycle?

    a. an evaporator, condenser, compressor, a metering device.
    b. an evaporator, condenser, low pressure switch, a metering device.
    c. a condenser, compressor, heat exchanger, a metering device.
    d. just your evaporator, condenser and compressor.

100. What is the purpose of a condenser?

    a. remove heat.
    b. add heat.
    c. hold refrigerant vapor.
    d. separate the compressor from the evaporator.

101. What type of compressors are quite similar in construction to a gasoline engine?

    a. rotary compressor.
    b. centrifugal compressor.
    c. diaphragm type.
    d. reciprocating compressor.

102. When is a centrifugal compressor used?

    a. in large air conditioning installations.
    b. on large walk-in coolers.
    c. on automotible air conditioners.
    d. in domestic refrigeration equipment.

103. What type of compressor is most commonly used in the refrigeration industry?

    a. rotary.
    b. reciprocating.
    c. centrifugal.
    d. diaphragm.

104. On reciprocating compressors what are the gaskets made out of?

    a. paper and lead.
    b. plastic and cork.
    c. cork and lead.
    d. paper and cork.

75.02.05.00 (continued)

105. What type of material is used on compressors used in automotible air conditioning systems?

    a. teflon coated.
    b. synthetic rubber seal.
    c. graphite seal.
    d. bronze seal.

106. What type of compressor operates with revolving circular impellers connected in multiple stages?

    a. reciprocating.
    b. centrifugal.
    c. rotary.
    d. gear type compressor.

107. In a force feed or pressure system, what is used to move the oil?

    a. small oil pump.
    b. a transfer motor.
    c. an oil diverter.
    d. an oil separator.

108. What is used to prevent excess oil pressure in the system?

    a. an overload release valve.
    b. a high pressure kick out switch.
    c. a temperature pressure release valve.
    d. a safety release valve.

109. What are the requirements of a good lubricant for refrigeration equipment?

    a. must be moisture free, wax free and unfoaming.
    b. it has to be a synthetic oil.
    c. it must be heat treated, wax free and free of impurities.
    d. it is a combination of synthetic and low on viscosity oil.

110. What type of oil is used in a sealed system?

    a. 10 weight.
    b. multi weight.
    c. high detergent.
    d. special prepared mineral oil.

75.02.06.00

111. What is the purpose of a capillary tube?

    a. it separates the high side from the low side.
    b. it is a metering device for refrigerant.
    c. it is used to create a high pressure area.
    d. it controls the temperature of the evaporator in the system.

75.02.06.00 (continued)

112. How many moving parts are there in a capillary tube?

a. 1
b. 2
c. 3
d. none.

113. What will happen to a capillary tube if there is moisture in the system?

a. nothing.
b. it will over heat the system.
c. the moisture will form ice and cause blockage.
d. the moisture will clean the wax from the cap tube.

114. What is the purpose of an automatic expansion valve?

a. it separates the high side from the low side.
b. it creates a low pressure area on the high side.
c. it throttles the liquid refrigerant.
d. it separates the evaporator from the condenser.

115. What type of automatic expansion valve do you use when you want the pressures in the system to equalize when the system cycle is off?

a. diaphragm type.
b. bypass automatic expansion valve.
c. bellow type.
d. electrically controlled type.

116. When you have a leaky valve, what are the symptoms?

a. frosting of the suction line.
b. extremely high head pressure.
c. higher than normal low side pressure.
d. low amp pull.

117. Where should the bulb in the thermostatic expansion valve be located?

a. near the inlet of the evaporator.
b. near the outlet of the evaporator.
c. in the middle of the evaporator.
d. just before the metering device.

118. How are thermostatic expansion valves rated?

a. in pounds per square inch.
b. in tons.
c. in BTU's.
d. in super heat.

75.02.06.00 (continued)

119. What is an equalizer tube used with the thermostatic expansion valve?

a. on any unit larger than 3 tons.
b. on any unit larger than 5 tons.
c. if there is more than a 4 PSI between the inlet of the evaporator and outlet.
d. if there is more than a 10 PSI between the inlet and the outlet of the evaporator.

120. How many types of check valves are there?

a. 2, disc and solid ball.
b. 3, disc, solid ball and square type.
c. just one, disc type.
d. just one, solid ball type.

121. How many types of solenoid are in common use?

a. 3
b. 2
c. 1
d. 7

122. When a 4-way valve is de-energized, in what mode is the heat pump?

a. in the cooling mode.
b. in the heating mode.
c. in neither mode.
d. in the defrost cycle.

75.02.07.00

123. What is the most common type of thermostat?

a. bi-metal strip.
b. series with resistance strip.
c. high pressure overload switch.
d. low pressure relay overload control inductor switch.

124. On a thermostat, what does a differential adjustment control screw do?

a. it adjusts the humidity control.
b. the temperature between cut-out and cut-in.
c. the super-heat cut-in and cut-out.
d. it adjusts the on time of the compressor.

125. What is the purpose of the altitude adjustment control?

a. it affects the thermostat used in commercial airplanes that are carrying refrigeration equipment.
b. it is only used in walk-in coolers.
c. it is used to adjust the cold control to various altitudes.
d. it anticipates altitude change.

75.02.07.00 (continued)

126. How many types of starting relays are used in refrigeration?

    a. 2
    b. 3
    c. 4
    d. 6

127. Which type of relay works off voltage?

    a. current type.
    b. thermo type.
    c. potential type.
    d. resistance type.

128. What is the most effective way to determine if the relay is causing trouble?

    a. use a jump test box.
    b. check the thermostat to see if it's working.
    c. check all other parts of the circuit.
    d. make sure the capacitor is closed.

129. Motor uses may be grouped as follows: (Which one is not correct)

    a. to drive compressors.
    b. to drive fans.
    c. to drive pumps.
    d. to drive solenoids.

130. What is used to protect the motor from excess starting current?

    a. bi-metal type overload.
    b. a fusetron.
    c. a cartridge fuse.
    d. resistance plug wire.

131. In a hermetic split phase induction motor, what winding would have the most resistance?

    a. start winding.
    b. main winding.
    c. both the same.
    d. auxiliary winding.

132. How many methods are there of starting a stuck compressor?

    a. 1
    b. 2
    c. 3
    4. 4

133. What is used to check a hermetically sealed compressor?

    a. compressor analyzer.
    b. a resistance meter.
    c. a capacitor analyzer.

75.02.07.00 (continued)

134. On a heat pump, when the system goes into defrost, the defrost timer is energizing the heater for what unit?

    a. the evaporator coil.
    b. the condenser coil.
    c. the indoor coil.
    d. the outdoor coil.

135. Besides cycling the defrost heater, what else does the defrost timer do?

    a. it cycles the evaporator high limit switch.
    b. it cycles the evaporator low limit switch.
    c. it cycles the compressor.
    d. it will turn power off to the interior light of the refrigerator.

75.02.08.00

136. In most domestic refrigerators, what are the evaporators made out of?

    a. aluminum and stainless steel.
    b. aluminum and copper.
    c. copper and stainless steel.
    d. copper and chrome plated brass.

137. What is one major achievement that helped the refrigeration industry?

    a. the hermetically sealed compressor.
    b. the teflon seal.
    c. the invention of freon.
    d. the invention of the rotary compressor.

138. What are the two basic types of air conditioning systems used in homes?

    a. self-contained and remote.
    b. water cooled and sealed systems.
    c. remote and window units.
    d. window units and self-contained.

139. What is one of the most important parts of an air conditioner?

    a. high pressure release valve.
    b. wiring diagram.
    c. thermostat know.
    d. the ice control.

140. What does an air conditioner remove besides heat?

    a. condensation.
    b. odors.
    c. smoke.
    d. dust particles from the air.

75.02.08.00 (continued)

141. On a manual defrost freezer, why does ice form on the top shelf first?

    a. hot air rises, cold air falls.
    b. cold air rises, hot air falls.
    c. forms on the bottom first.
    d. because the instructor said so.

142. When defrosting a freezer, what must you be careful of?

    a. long periods where the freezer may stand idle.
    b. overheating the evaporator coil with hot water.
    c. not to leave the door shut, because odor and bacteria will form.
    d. poling the evaporator with sharp objects.

143. What causes freezer burn?

    a. increase moisture.
    b. loss of moisture.
    c. not cold enough temperature.
    d. too cold of temperature.

144. What is the purpose of a heat pump?

    a. transfer refrigerant.
    b. transfer heat.
    c. remove cold air.
    d. clean the air.

145. When there is no power to the four way valve, in what mode is the valve?

    a. heating mode.
    b. cooling mode.
    c. cleaning mode.
    d. in neither heating or cooling.

146. What is the difference in suction and liquid line of a heat pump compared to central air?

    a. they are generally smaller.
    b. they are about the same.
    c. they are generally larger.
    d. there is no difference.

147. When replacing the four-way valve, what is the most important thing to remember?

    a. to use good epoxy.
    b. to clean all joints using a round file.
    c. make sure the 3 ports are to the top.
    d. use a heat sink to prevent damage to the valve.

75.02.08.00 (continued)

148. What is placed on the suction line to prevent slugging of the compressor?

a. liquid receiver.
b. cumulator.
c. pressure invertor valve.
d. suction trap.

149. How many thermostat expansion valves are used in the heat pump?

a. 4
b. 3
c. 2
d. none

150. In a humidifier, where does the moisture condense?

a. on a condenser coil.
b. on the evaporator.
c. in the compressor.
d. on the condenser plates.

151. What is a dehumidifier made up of?

a. basically like a heat pump.
b. small hermetic refrigeration system.
c. similar to a freezer.
d. operates like a car air conditioner.

152. Where does the condensation go in a dehumidifier?

a. in a collecting container.
b. it's evaporated.
c. it's piped into the drain.
d. there is no condensation.

153. What is the most popular type of refrigerant used in auto air conditioning?

a. refrigerant 22
b. refrigerant 502
c. refrigerant 11.
d. refrigerant 12.

154. What engages the compressor?

a. the thermostat.
b. electromagnetic clutch.
c. power clutch.
d. pnuematic clutch.

155. What usually causes the majority of leaks in the car air conditioner?

a. poor joints.
b. leaky evaporator.
c. leaky condenser.
d. compressor seal wearing out.

75.02.08.00 (continued)

156. What side do you charge a car air conditioner when running?

   a. the high side.
   b. on either side.
   c. the low side.
   d. both sides at the same time.

157. How many inches of vacuum should a good compressor pump?

   a. 12
   b. 14
   c. 11
   d. 15

158. When working with refrigerant, a service technician should always:

   a. be careful not to invert the can.
   b. wear goggles.
   c. wear gloves.
   d. work in a well lighted area.

75.02.09.00

159. Where is the evaporator located in a walk-in cooler?

   a. on the unit.
   b. along side the unit.
   c. inside the walk-in cooler.
   d. under the walk-in cooler.

160. In which position should the valve be turned when obtaining access to the service port?

   a. all the way in.
   b. all the way out.
   c. it doesn't matter.
   d. 3/4 of a turn in.

161. What is used to absorb moisture and any foreign particles in a refrigeration system?

   a. an accumulator.
   b. a receiver.
   c. the evaporator.
   d. a filter dryer.

162. What controls the amount of water flowing through a water cooled condenser?

   a. water pressure switch.
   b. globe valve.
   c. gate valve.
   d. water operated low pressure solenoid valve.

75.02.09.00 (continued)

163. What do you use to check for acid content in a sealed system?

a. acid test kit.
b. pressure drop across the filter.
c. acid analyzer.
d. paint discoloration of sight glass.

164. On a self-contained display case, where is the compressor located?

a. in an adjoining room.
b. in the basement below the unit.
c. in the display case underneath.
d. in the evaporator compartment.

165. When charging a sealed system, after hooking up manifold gauges, what must you do?

a. invert refrigerant bottle.
b. bleed hoses.
c. check for acid system.
d. remove head pressure.

166. What controls the defrost cycle of a display case?

a. defrost timer.
b. defrost bi-metal.
c. high pressure overload switch.
d. low pressure overload switch.

167. What controls the water flow in an ice maker?

a. floats and solenoids.
b. floats and valve switches.
c. valve switches and water pressure dispensers.
d. water release valve and floats.

168. On an ice cube maker, what releases a slab of ice off the evaporator?

a. hot water from a boiler.
b. hot condensor gas.
c. heaters that are energized.
d. from a salt mixer sprayed on the slab.

169. What cuts the slab off in an ice cube maker?

a. electrical grids.
b. solenoid cutter.
c. ice chisels.
d. shape hydrologic knives.

75.02.10.00

170. What type of voltage is the air passed through in an electronic air cleaner?

    a. high voltage.
    b. low voltage.
    c. resistance voltage.
    d. direct voltage.

171. At what approximate voltage does electronic air cleaner operate at?

    a. 4,000 volts.
    b. 6,000 volts.
    c. 24,000 volts.
    d. 12,000 volts.

172. How are particles collected on the plates?

    a. the dirt particles pass through an inonized field.
    b. the dirt is attracted to the magnesium plates.
    c. the dust is attracted by a magnetic force.
    d. the dust particles are absorbed by the nitrogen content of the aluminum plates.

173. What is the purpose of a humidifier?

    a. take moisture out of the air.
    b. put moisture into the air.
    c. clean the air.
    d. humidify the oxygen in the air.

174. What is a media pad used for in a humidifier?

    a. absorb and transport moisture.
    b. prevent vibration in the humidifier.
    c. keep the humidifier from over heating.
    d. catch over flowing water.

175. When mounting a furnace humidifier you should make sure the unit is:

    a. level.
    b. secure with rubber mounts.
    c. in a well ventilated area.
    d. installed on a cold air return of the heat system.

75.02.11.00

176. Name three (3) models of forced air furnaces:

    a. upflow, downflow, crossflow.
    b. downflow, horizontal flow, reverse flow.
    c. upflow, downflow, horizontal flow.
    d. crossflow, reverse flow, downflow.

75.02.11.00 (continued)

177. Name the coil that isn't used in a typical central air:

a. a coil.
b. flat coil.
c. slant coil.
d. round coil.

178. Architectural drawings are prepared:

a. symbolically.
b. carefully.
c. rapidly.
d. systematically.

179. When is an extended plenium system used?

a. single story.
b. two story.
c. brick houses.
d. wood houses.

180. When is a flat coin used?

a. with horizontal furnace.
b. with upflow furnace.
c. with counterflow furnace.
d. with crossflow furnace.

181. How many volts are run to condensing unit on a typical system?

a. 110
b. 208
c. 440
d. 38

182. What do you war when soldering, brazing and drilling?

a. safety goggles.
b. long sleeve shirt.
c. steel tipped boots.
d. gloves.

183. When you notice an unsafe condition you:

a. avoid it.
b. put up a warning sign.
c. inform supervisor.
d. forget about it.

75.02.11.00 (continued)

184. What is a means of reducing a building dimension:

   a. shortening dimension.
   b. rounding it off to the lowest #.
   c. drawing it to scale.
   d. shrinking.

185. When dealing with a customer, what should be your guide?

   a. basic common sense.
   b. money involved.
   c. PR rule
   d. standard operating procedures.

COURSE TEST ANSWER SHEET

Occupational Area: Heating, Refrig., & Air Conditioning
File Code: 751.02.00.00
Name: ____________________
Family Pay Number: ____________________ **Sex: M F (Circle 1)**

ANSWERS

75.02.01.01	1.	B	01.07	21.	B	02.03	41.	A
	2.	A		22.	B		42.	C
	3.	C		23.	A		43.	B
75.02.01.02	4.	B	01.08	24.	C		44.	B
	5.	A		25.	B	02.04	45.	C
75.02.01.03	6.	B		26.	C		46.	A
	7.	A		27.	D		47.	B
	8.	C		28.	C	02.05	48.	C
75.02.01.04	9.	D		29.	A		49.	A
	10.	C		30.	D	02.06	50.	C
	11.	B	02.01	31.	C		51.	A
	12.	A		32.	C		52.	A
	13.	A		33.	C	02.07	53.	B
	14.	B		34.	A		54.	A
75.02.01.05	15.	A		35.	C	02.08	55.	B
	16.	D		36.	A		56.	B
	17.	A	02.02	37.	A		57.	A
75.02.01.06	18.	A		38.	C		58.	B
	19.	A		39.	D		59.	A
	20.	C	02.03	40.	B		60.	A

COURSE TEST ANSWER SHEET

Occupational Area: Heating, Refriq., & Air Conditioning
File Code: 751.02.00.00
Name:
Family Pay Number:

Sex: M F (Circle 1)

ANSWERS

75.02.02.09	61.	A	75.02.04.01	81.	A	05.02	101.	D
	62.	A	04.02	82.	A		102.	A
	63.	B		83.	A		103.	B
02.10	64.	C		84.	D	05.03	104.	A
	65.	B	04.03	85.	A		105.	A
75.02.03.01	66.	C		86.	B		106.	B
	67.	D		87.	B	05.04	107.	A
	68.	A	04.04	88.	B		108.	D
03.02	69.	B		89.	C		109.	A
	70.	C		90.	A		110.	D
	71.	C		91.	D	75.02.06.01	111.	B
	72.	B		92.	A		112.	D
03.03	73.	D	04.05	93.	B		113.	C
	74.	C		94.	B	06.02	114.	C
03.04	75.	A		95.	D		115.	B
	76.	C		96.	B		116.	A
	77.	B		97.	C	06.03	117.	B
	78.	A		98.	D		118.	B
75.02.04.01	79.	D	75.02.05.01	99.	A		119.	C
	80.	C		100.		06.03, .04, .05	120.	A

COURSE TEST ANSWER SHEET

Occupational Area: Heating, Refrig., & Air Conditioning
File Code: 751.02.00.00
Name: ______________ Sex: M F (Circle 1)
Family Pay Number: ______________

ANSWERS

75.02.06.04, .05	121.	A	75.02.08.03	141.	A		161.	D
.06	122.	A		142.	D		162.	A
07.01	123.	A		143.	B		163.	A
	124.	D	08.04	144.	B	75.02.09.02	164.	C
	125.	C		145.	B		165.	B
07.02	126.	B		146.	C		166.	A
	127.	C		147.	D	09.03	167.	A
	128.	C		148.	B		168.	B
07.03	129.	D		149.	C		169.	A
	130.	A	08.05	150.	B	75.02.10.01	170.	A
	131.	A		151.	B		171.	D
	132.	C		152.	A		172.	A
	133.	A	08.06	153.	D	10.02	173.	B
07.04	134.	D		154.	B		174.	A
	135.	C		155.	D		175.	A
08.01	136.	A		156.	C	75.02.11.01	176.	A
	137.	A		157.	D		177.	D
08.02	138.	B		158.	B	11.02	178.	A
	139.	B	75.02.09.01	159.	C		179.	B
	140.	A		160.	A		180.	A

COURSE TEST ANSWER SHEET

Occupational Area: Heating, Refrig., & Air Conditioning
File Code: 751.02.00.00
Name: ______________ Sex: M F (Circle 1)
Family Pay Number: ______________

ANSWERS

75.02.11.03 181. B
182. A
183. C
11.04 184. C
11.05 185. A
186. ____
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239. ____
240. ____

File Code: 751.02.01.01

Date Published: 11/7/77

Mountain-Plains Education &
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(Glasgow AFB, Montana 59231

Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: HAND TOOLS

INTRODUCTION:

This LAP will cover the use of selected refrigeration hand tools. The only prerequisite is to have read the previous LAPS.

REVIEW:

Air conditioning and heating systems have many electrical and mechanical components. To be able to service the equipment, a good knowledge of hand tools, and how to use them, is needed. Some of these tools are screwdrivers, wrenches, tube benders, flaring tool, swagging tools, and pipe cutters. Proper use of basic tools is important in doing good work.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Identify the different types of hand tools used for heating and refrigeration.
2. Be able to properly use the tools in a safe and appropriate manner.

DISCUSSION:

Study the chapter in Modern Refrigeration and Air Conditioning which covers basic hand tools.

DEMONSTRATION:

No demonstration is required unless you have problems or questions.

PERFORMANCE:

Have your instructor give you the list of tools to use in this LAP. Use each tool according to recommended procedures. Your work will be more professional in looks and functions, and your tools will last longer if used properly.

Principal Author(s): John Carey

EVALUATION:

Notify the instructor when you are ready to take the written test. Have the instructor evaluate your performance test. All items should be accomplished successfully.

SUMMARY:

Go over the test with the instructor. You should now understand:

1. What the basic refrigeration and heating hand tools are.
2. How to use them safely and effectively.

Upon successful completion of the tests, you can enter your completion of this LAP on your SPR and continue to the next.

Student: ______________________ **File Code:** 751.02.01.01

Date: ______________________ **Date Published:** 11/17/77

Family
Education
Program

LAP TEST: HAND TOOLS

1. What are swagging tools used for?

   a. swagging fittings.
   b. enlarging tubing ends.
   c. reducing tubing ends.
   d. pinching of tubing ends.

2. What is a manifold set used for?

   a. checking high and low set pressures.
   b. checking moisture level in a seal system.
   c. checking CO2 content.
   d. checking resistance of refrigerant.

3. What is used to measure vacuum and pressure?

   a. relief gauge.
   b. compound gauge.
   c. pressure gauge.
   d. device gauge.

4. Should one push or pull a wrench?

   a. depends on size of wrench.
   b. it is safer to pull on a wrench.
   c. it is safer to push a wrench.
   d. it depends on if you are left or right handed.

5. What type of file would you use to cut cap tube?

   a. flat file.
   b. round file.
   c. three (3) cornered file.
   d. finger file.

6. When cleaning a copper fitting with a brush which way do you rotate the brush?

   a. clockwise.
   b. counter clockwise.
   c. both directions.
   d. it doesn't matter.

7. What temperature does water start to freeze using a Fahernheit thermometer?

   A. 0 degrees.
   B. 31 degrees.
   C. 32 degrees.
   D. -1 degrees.

8. What type of wrenches are used on refrigeration lines?

   A. Flair nut.
   B. Long nose pliers.
   C. Pliers.
   D. Water pump pliers.

9. What is used to close off a tubing end before soldering?

   A. Vice grip.
   B. Hammer and chisel.
   C. Pinch off tool.
   D. Crimp of tubing.

10. When using a hand saw the cut is made on one?

    A. Back stroke.
    B. Forward stroke.
    C. Either direction.
    D. Depending on the blade.

File Code: 751.02.01.02

Date Published: 11/14/77

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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: TORCH AND TIPS

INTRODUCTION:

This LAP will cover the use of torches and tips used in refrigeration repairs. There is no prerequisite other than reading the previous LAP.

REVIEW:

To be able to service cooling systems, a technician must know how to use the proper torch and tips. Many of the service jobs will require changing components that were installed with silver solder.

SKILL COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Identify the different types of torches and tips.
2. Be able to use them in a safe and proper manner.

DISCUSSION:

Study the chapter in Modern Refrigeration and Air Conditioning which covers torches and tips.

DEMONSTRATION:

No demonstration necessary unless you have problems.

PERFORMANCE:

Have your instructor give you the experiment for this LAP covering the use of torch and tips.

EVALUATION:

Notify the instructor when you are ready to take the written test. Have the instructor evaluate your performance test. All items should be accomplished successfully.

Principal Author(s): John Carey

SUMMARY:

Go over the test with the instructor. You should now understand:

1. The different types of torch and tips used in refrigeration.
2. How to use them safely and effectively.

Upon successful completion of the tests, fill out the SPR and proceed to the next LAP.

Student: ______________________ File Code: 751.02.01.02

Date: ______________________ Date Published: 11/17/77

Family Education Program

LAP TEST: TORCH TIPS

1. Name three (3) types of torch tips.

   A. Single tip, double tip, triple tip.
   B. Single, double, twister.
   C. Single, twister, triple.
   D. Take your choice.

2. What fuel is used for silver soldering?

   A. LP gas.
   B. Propane.
   C. Natural gas.
   D. Acetylene.

3. Using a twister tip what do you do with the regulator?

   A. Set for 6½ pounds.
   B. Turn all the way up.
   C. Turn all the way down.
   D. Set for 12 pounds.

4. When using a torch you should?

   A. Be in a well ventilated area.
   B. Wear dark glasses.
   C. Turn safety valve on.
   D. Turn safety valve off completely.

5. A tank should be?

   A. Secured properly so it doesn't tip.
   B. Turned over to get more gas out.
   C. Vertical position with valve off.
   D. Heated to the proper temperature.

6. What changes pressure coming out of the torch?

   A. Valve.
   B. The tip.
   C. The regulator.
   D. The restriction of hose.

7. When would you use a double tip torch?

   A. On large copper tubing.
   B. On small tubing.
   C. When soldering inverted joints.
   D. In hard to reach places.

8. Why should you never silver solder cap tube with twister torch?

   A. The flux ruins cap tube.
   B. Cap tube will become plugged.
   C. Torch will become plugged.
   D. Cap tube will become too hot.

9. How hot does the material have to be to silver solder?

   A. 900 degrees.
   B. 1600 degrees.
   C. 700 degrees.
   D. 1100 degrees.

10. When done with torch and tip make sure?

   A. The tank is turned off and hose is bled.
   B. Turn up tank and turn down regulator.
   C. Turn regulator off and bleed hose.
   D. Change the tip.

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File Code: 751.02.01.03

Date Published: 11/14/77

Learning Activity Package

Student: ______________

Date: ______________

PERFORMANCE ACTIVITY: LEAK DETECTOR

INTRODUCTION:

This LAP will cover the use of selected types of leak detectors used in refrigeration. The only prerequisite is to have read and completed the previous LAPS.

REVIEW:

A refrigeration system has to be completely sealed without leaks to operate effectively. There are several methods to check for leaks. To be an effective serviceman, you will have to know how to use the leak detectors.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following.

1. Know the different types of leak detectors.
2. Be able to use them safely in an appropriate manner.

DISCUSSION:

Study the chapter in Modern Refrigeration and Air Conditioning on Commercial Systems Installing and Servicing, and the chapter in Getting Started in Heating and Air Conditioning Service covering leak detectors.

DEMONSTRATION:

Have your instructor demonstrate if you have problems.

PERFORMANCE:

Have your instructor give you the experiment for this LAP covering leak detectors.

Principal Author(s): John Carey

EVALUATION:

Notify the instructor when you are ready to take the written test. Have the instructor evaluate your performance test. All items should be completed successfully.

SUMMARY:

Go over the test with the instructor. You should now understand the following:

1. The different types of detectors used in refrigeration.
2. How to use them in a safe and appropriate manner.

After successful completion you can fill out SPR and proceed to the next LAP.

Student: ______________________ File Code: 751.02.01.03

Date: ______________________ Date Published: 11/17/77

Family
Education
Program

LAP TEST: LEAK DETECTORS

1. Name four (4) types of leak detectors?

   A. Electronic, halite, bubble solution, dytell.
   B. Electronic, dytell, bubble solution, vinegar.
   C. Smoke, hydrolic detector, dytell, halite.
   D. Electronic, halite, bubble solution, carbic acid.

2. What is the most accurate type of leak detector?

   A. Bubble solution.
   B. Halite.
   C. Electronic detector.
   D. Smoke

3. Why should a halite leak detector be used in a well ventilated room?

   A. Smells terrible.
   B. Makes you high.
   C. Gives off toxic fumes.
   D. Very sensitive.

4. What is the simplest leak detector to use?

   A. Electronic leak detector.
   B. Bubble solution.
   C. Halite torch.
   D. Absorption detector.

5. Why should you be very careful when using leak detectors?

   A. Working with high voltage.
   B. Gives off toxic fumes.
   C. Expensive and very sensitive.
   D. Could cause explosion.

6. What is the first thing you do when using electronic leak detectors?

   A. Warm it up.
   B. Solution on it.
   C. Calibrate it.
   D. Clean tip.

7. When checking for leaks on low side have unit?

   A. Turned off.
   B. Turned on.
   C. Have cycled three (3) times.
   D. Evacuate system.

8. Is it safe to check for leaks on high side with unit running?

   A. Yes.
   B. No.
   C. Sometimes.
   D. Only on central air.

9. Why do you check around bottom of joint for leak?

   A. Leaks accure on bottom.
   B. Easier to check bottom.
   C. Refrigerant is heavier and air tends to fall.
   D. Solder flows poorly at bottom of joint.

10. What color shows on halite torch when a leak is detected?

   A. White.
   B. Brown.
   C. Green.
   D. Aqua.

File Code: 751.02.01.04

Date Published: 11/14/77

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Learning Activity Package

Student: ____________

Date: ____________

PERFORMANCE ACTIVITY: VACUUM PUMPS

INTRODUCTION:

This LAP will cover the use of a vacuum pump, care and maintenance. The only prerequisite is to have read and successfully completed the previous LAP.

REVIEW:

A refrigeration system has to be completely dry and uncontaminated to operate properly. To obtain a dry system you need a vacuum pump capable of pulling a deep vacuum.

SKILL COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Know the types of pumps available.
2. Know how to operate the pump safely in an appropriate manner.

DEMONSTRATION:

No demonstration necessary unless you have problems.

DISCUSSION:

Study the chapter in Domestic Hermetic Systems and Servicing covering deep vacuum pumps.

PERFORMANCE:

Go over the operating procedures for the vacuum pump.

Principal Author(s): John Carey

EVALUATION:

Notify the instructor when you are ready to take the written test. Have the instructor evaluate your performance test. All items should be completed successfully.

SUMMARY:

Go over the test with the instructor. You should now understand the following:

1. What a vacuum pump is.
2. How it is used.
3. How to take care of it.

After successful completion you can fill out SPR and proceed to the next LAP.

Student: ______________________ **File Code:** 751.02.01.04

Date: ______________________ **Date Published:** 11/17/77

Family Education Program

LAP TEST: VACUUM PUMPS

1. Why is a vacuum pump used in refrigeration?

   a. lower pressure in system.
   b. removes moisture and impurities from system.
   c. clean compressor out.
   d. make easier charge system.

2. Why should you change oil in a compressor periodically?

   a. oil becomes rusty.
   b. oil will plug compressor.
   c. oil turns dark black.
   d. oil becomes contaminated.

3. To pull a deep vacuum what should your micron gauge read?

   a. 1,000
   b. 2,000
   c. 3,000
   d. 300

4. How long should a vacuum be pulled on a system?

   a. 3 hours.
   b. 7 hours.
   c. depends on a wet or dry system.
   d. 1½ hours.

5. Name two (2) ways of checking a vacuum?

   a. with a manometer and set of gauges.
   b. with a manometer and micron gauge.
   c. with a micron gauge and manifold set.
   d. with a static gauge and manometer.

6. What is used with a vacuum pump to see if you have a tight system?

   a. high vacuum manifold set.
   b. low vacuum manifold set.
   c. static pressure gauge.
   d. system analyzer.

7. What type of oil is used in a vacuum pump?

   a. any good non detergent oil.
   b. thirty (30) weight.
   c. vacuum pump oil.
   d. ten (10) weight.

8. Why must you be careful when charging a system to isolate the vacuum pump?

   a. refrigerant can damage pump.
   b. vacuum pump can suck oil out.
   c. may damage manifold set.
   d. may rupture a hose.

9. What is considered a complete vacuum?

   a. 29.2 inches mercury.
   b. 30.05 inches mercury.
   c. 28.95 inches mercury.
   d. 27.35 inches mercury.

10. How is a vacuum measured?

    a. pounds per square inch.
    b. in inches of mercury.
    c. in feet of mercury.
    d. in BTU's.

File Code: 751.02.01.05

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Learning Activity Package

Student: ________________

Date: ________________

PERFORMANCE ACTIVITY: CHARGE CYLINDER

INTRODUCTION:

This LAP will cover the use and operation of a charging cylinder. The only prerequisite is to have read and successfully completed the previous LAPS.

REVIEW:

To accurately charge a system, a charging cylinder is used to measure the amount of refrigerant to be put into the system.

SKILL COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Know the different types of charging cylinders.
2. Be able to use it safely and accurately.

DISCUSSION:

Study the chapter in Modern Refrigeration and Air Conditioning covering charging cylinders.

DEMONSTRATION:

No demonstration needed unless you have problems.

PERFORMANCE:

Go over the operating procedures for filling and using a charging cylinder.

EVALUATION:

Notify the instructor when you are ready to take the written test. Have the instructor evaluate your performance test. All items should be completed successfully.

Principal Author(s): John Carey

SUMMARY:

Go over the test with the instructor. You should now understand the following:

1. Different types of cylinders used.
2. Use it safely and accurately.

After successful completion, fill out SPR and proceed to the next LAP.

Student: ____________________ File Code: 751.02.01.05

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST: CHARGING CYLINDER

1. When is a charging cylinder used?

   A. To check a vacuum.
   B. To check for leaks.
   C. To measure charge.
   D. To drain a refrigeration system.

2. If you open the top valve in a charging cylinder you will get?

   A. A liquid.
   B. A gas.
   C. Neither.
   D. A pressure semi-liquid.

3. If you open the bottom valve you will get?

   A. Liquid.
   B. Gas.
   C. Solids.
   D. Neither.

4. How is the scale marked off in a charging cylinder?

   A. Pounds & ounces.
   B. Pints & quarts.
   C. Grams.
   D. Miligrams.

5. If you can not get a complete charge in a system what do you use to force the rest of the refrigerant in with?

   A. A vacuum pump.
   B. A hi-pressure pump.
   C. A refrigerant expansion tool.
   D. Plug in a heater to build up pressure.

6. What is the gauge on top of a charging cylinder measured in?

   A. Degrees fahrenheit.
   B. Degrees centigrade
   C. Pounds per square inch.
   D. Ounces per square inch.

7. Name 2 types of refrigerant used in a charging cylinder?

   A. Refrigerant 709 & 803.
   B. R 12 & R 22.
   C. R 621 & R 704.
   D. R 14 & R 29.

8. What is the maximum pressure to be applied to a charging cylinder?

   A. 800 pounds.
   B. 600 pounds.
   C. 300 pounds.
   D. 125 pounds.

9. When charging a system that is running you charge from?

   A. Both hi and low sides.
   B. Just the high side.
   C. Just low side.
   D. Doesn't matter.

10. When charging a system that isn't running you charge from?

   A. High side.
   B. Low side.
   C. Both sides.
   D. Doesn't matter.

File Code: 751.02.01.06

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Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: MISCELLANEOUS MATERIAL

INTRODUCTION:

This LAP will cover the use of miscellaneous material used in refrigeration and heating. The only prerequisite is to have read and completed successfully the previous LAPS.

REVIEW:

There are special materials used in refrigeration and heating that a technician must know about. Some of these are oils, solvent, and abrasives.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Know why these special materials are used.
2. Know how to use them safely and accurately.

DISCUSSION:

Study the chapter in Modern Refrigeration and Air Conditioning covering Special Materials.

PERFORMANCE:

NONE

EVALUATION:

Notify the instructor when you are ready to take the written test. All items should be completed successfully.

Principal Author(s): John Carey

SUMMARY:

Go over the test with the instructor. You should now understand the following.

1. Why these materials are used.
2. How to use them.

After successful completion of this LAP you can fill out SPR and proceed to the next LAP.

Student: ____________________ **File Code:** 751.02.01.06

Date: ____________________ **Date Published:** 11/17/77

Family Education Program

LAP TEST

1. What type of oil is used in a refrigeration system?

    a. 10 weight.
    b. 20 weight non detergent.
    c. 10-40 high detergent oil.
    d. special prepared mineral oil.

2. Viscosity is time in seconds it takes for a definite quantity of oil to flow through?

    a. 100 degrees fahrenheit.
    b. 100 degrees centigrade.
    c. 70 degrees fahrenheit.
    d. 211 degrees fahrenheit.

3. Oil must have a minimum of?

    a. carbon acid.
    b. moisture wax and foreign matter.
    c. moisture and non hydro carbon.
    d. rust inhibitors and friction adhesive.

4. What is used to test oil for moisture content?

    a. dialectric test.
    b. moisture meter.
    c. moisture indictor test.
    d. hydroelectric test.

5. What is an abrasive used for?

    a. to braze steel.
    b. cleaning and smoothing surface.
    c. to raise temperature in copper.
    d. to eliminate moisture content.

6. Should gasoline be used for a cleaner?

    a. only in a well ventilated area.
    b. yes.
    c. no.
    d. on condensers only.

7. Can a person use carbon Tetrochloride for cleaning?

   a. yes.
   b. no.
   c. only on condensers.
   d. only on vaporators.

8. What does cleaning solvent do?

   a. remove moisture, oil, and grease sludge.
   b. removes oil, grease, and any burrs in pipe.
   c. removes oil, sludge, grease and installation from windings.
   d. removes oil, sludge and all stoppages.

9. What are gaskets used for?

   a. to hold joints together.
   b. to act as a cushion.
   c. seal joints between assembled parts.
   d. to prevent vibration.

10. What are 2 popular types of gaskets?

   a. steel and iron.
   b. lead and aluminum.
   c. wood and cork.
   d. cork and lead.

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File Code: 751.02.01.07

Date Published: 11/14/77

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: REFRIGERANT

INTRODUCTION:

This LAP will cover the use of refrigerants and safe handling of them. The only prerequisite is to have read and completed successfully the previous LAP.

REVIEW:

A refrigeration system has to be properly charged with the right refrigerant to operate properly. There are several types of refrigerants used for the many different refrigeration systems available today. It is important for the technician to be careful handling refrigerant because it can be dangerous.

SKILL COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Know the different refrigerants available.
2. Know how to handle the refrigerant safely.
3. Know what type of system it is used for.

DISCUSSION:

Study the chapter in Modern Refrigeration and Air Conditioning covering Types of Refrigerant.

PERFORMANCE:

Have the instructor show you how to fill a charging cylinder.

EVALUATION:

Notify the instructor when you are ready to take the written test. Have the instructor evaluate your performance test. All items should be completed successfully.

Principal Author(s): John Carey

SUMMARY:

Go over the test with the instructor. You should now understand the following:

1. What refrigerants are available.
2. What systems they are used in.
3. How to handle the refrigerant safely.

After successful completion you can proceed to the next unit after taking this unit test and performance test.

Student: ______________________ **File Code:** 751.02.01.07

Date: ______________________ **Date Published:** 11/17/77

Family Education Program

LAP TEST: REFRIGERANTS AND PURPOSE

1. What type of refrigerant is commonly used in refrigerators?

   a. R-11
   b. R-12
   C. R-22
   D. R-504

2. What refrigerant is used as a good flushing agent?

   a. R-11
   B. R-12
   C. R-22
   D. R-113

3. What color can does refrigerant R-22 come in?

   a. white
   b. green
   c. blue
   d. orange

4. What color can does refrigerant R-12 come in?

   a. white
   b. green
   c. blue
   d. orange

5. Name 3 properties of R-12?

   a. colorless, odorless, doesn't burn.
   b. colorless, odorless, tasteless.
   c. colorless, tasteless, non-flammable.
   d. colorless, odorless, repells water.

6. Refrigerant R-22 is?

   a. lighter than air.
   b. heavier than air.
   c. same weight as air.
   d. same property as air.

7. As temperature refrigerant goes up the pressure?

   a. stays the same.
   b. doubles.
   c. goes down.
   d. goes up.

8. What is R-729?

   a. nitrogen.
   b. helium.
   c. air.
   d. argon.

9. Refrigerant coming from service cylinder in a normal position comes out as?

   a. liquid.
   b. gas.
   c. combination.
   d. none of the above.

10. When you invert a refrigerant cylinder, refrigerant comes out as?

   a. liquid.
   b. gas.
   c. combination.
   d. low pressure.

File Code: 751.02.01.08

Date Published: 11/14/77

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Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: COMMUNICATIONS

INTRODUCTION:

This LAP will cover communications between employees, employers, and customers. The prerequisite is to have read the introductory course and unit leg.

REVIEW:

Proper communications are needed to be an effective service technician. A service technician must be aware of himself, his abilities, the customer he deals with and his employer. Customer relations are a vital part of any service occupation as important as technical competence.

SKILL COMPETENCY:

Upon completion of this LAP, you will be able to demonstrate proper communication which includes the following:

1. Meet and greet customer.
2. Communicate with the customer to:
    a. Determine the complaint.
    b. Gain customer confidence.
    c. Diplomatically tell the customer about the appliance if needed.
    d. Present the bill while leaving good will.
    e. Make customer feel that he has received his money's worth of service.
3. Conduct yourself professionally.
4. Clean, neat and expedient manner.

DISCUSSION:

Study the chapter in Getting Started in Heating and Air Conditioning Service, covering communication.

Principal Author(s): John Carey

DEMONSTRATION:

Several discussions will be held with the instructor. Check with instructor before proceeding.

PERFORMANCE:

Your abilities in communications shall be monitored throughout the course.

EVALUATION:

Notify the instructor when you are ready to take the written test, all items should be accomplished successfully.

SUMMARY:

Go over the test with the instructor. You should understand the following:

1. How to communicate effectively with the customer and employer.
2. Conduct yourself professionally.
3. Meet and greet the public.
4. Have a clean and neat appearance.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ____________________ File Code: 751.02.01.08

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST

1. Name something to tell customers on new installation?
   - a. operation and guarantee.
   - b. operation and how long it will last.
   - c. guarantee and what problems to expect.
   - d. what to fix if it breaks.

2. What do you first check on a service call?
   - a. power cord.
   - b. if cooling.
   - c. customer complaint.
   - d. refrigerant level.

3. What is the basic rule in customer relations?
   - a. customer doesn't know what they are talking about.
   - b. customer is always right.
   - c. always be friendly and honest.
   - d. tell customer what he wants to hear.

4. Why are inventory reports important?
   - a. to check and see if employee is honest.
   - b. to keep inventory up to date.
   - c. to separate good from bad parts.
   - d. avoid tax problems.

5. Why have call reports been surveyed?
   - a. to see if employees are honest.
   - b. to get a chance to talk to customers.
   - c. to sell new products.
   - d. to make sure service is completed properly and fairly.

6. Why are trucks equipped with CB radios?
   - a. so the driver can have someone to talk to.
   - b. for emergencies only.
   - c. for rerouting.
   - d. makes it easier to find directions.

7. What does an employer look for in an employee?

   a. someone that makes a lot of money.
   b. someone that knows refrigeration.
   c. minority.
   d. someone good and punctual.

8. What does an employee expect from his employer?

   a. lots of money.
   b. good medical and dental benefits.
   c. appreciation and chance to advance.
   d. paid sick pay.

9. What does a customer expect from a company?

   a. honest service and fair prices.
   b. fast service.
   c. cheap price.
   d. get the shaft.

10. Why do you want to work?

    a. to make money.
    b. to feed 6 kids and wife.
    c. to keep up with the Jones.
    d. self satisfaction and accomplishment.

Student: ______________________ **File Code:** 751.02.01.00

Date: ______________________ **Date Published:** 12/2/77

Family Education Program

UNIT TEST: REFRIGERATION TOOLS, MATERIALS & REFRIGERANT

75.02.01.01

1. What are swagging tools used for?

   a. swagging fittings
   b. enlarging tubing ends
   c. reducing tubing ends
   d. pinching of tubing ends

2. What is used to measure vacuum and pressure?

   a. relief gauge.
   b. compound gauge.
   c. pressure gauge.
   d. device gauge.

3. When cleaning a copper fitting with a brush, which way do you rotate the brush?

   a. clockwise.
   b. counter clockwise.
   c. both directions.
   d. it doesn't matter.

4. What type of wrenches are used on refrigeration lines?

   a. flair nut.
   b. long nose pliers.
   c. pliers.
   d. water pump pliers.

5. What is used to close off a tubing end before soldering?

   a. vice grip.
   b. hammer and chisel.
   c. pinch of tubing.
   d. crimp of tubing.

75.02.01.02

6. Name three (3) types of torch tips.

   a. single tip, double tip, triple tip.
   b. single, double, twister.
   c. single, twister, triple.
   d. take your choice.

75.02.01.02 (continued)

7. What fuel is used for silver soldering?

   a. LP gas.
   b. propane.
   c. natural gas.
   d. acetylene

8. Using a twister tip what do you do with the regulator?

   a. set for 6½ pounds.
   b. turn all the way up.
   c. turn all the way down.
   d. set for 12 pounds.

9. How hot does the material have to be to silver solder?

   a. 900 degrees.
   b. 1600 degrees.
   c. 700 degrees.
   d. 1100 degrees.

10. When done with torch and tip make sure:

    a. the tank is turned off and hose is bled.
    b. turn up tank and turn down regulator.
    c. turn regulator off and bleed hose.
    d. change the tip.

75.02.01.03

11. Name four (4) types of leak detectors?

    a. electronic, halite, bubble solution, dytell.
    b. electronic, dytell, bubble solution, vinegar.
    c. smoke, hydrolic detector, dytell, halite.
    d. electronic, halite, bubble solution, carbic acid.

12. What is the simplest leak detector to use?

    a. electronic leak detector.
    b. bubble solution.
    c. halite torch.
    d. absorption detector.

13. What is the first thing you do when using electronic leak detectors?

    a. warm it up.
    b. solution on it.
    c. calibrate it.
    d. clean tip.

75.02.01.03 (continued)

14. Is it safe to check for leaks on high side with unit running?

   a. yes.
   b. no.
   c. sometimes.
   d. only on central air.

15. Why do you check around bottom of joint for leak?

   a. leaks accure on bottom.
   b. easier to check bottom.
   c. refrigerant is heavier and air tends to fall.
   d. solder flows poorly at bottom of joint.

17.02.01.04

16. Why is a vacuum pump used in refrigeration?

   a. lower pressure in system.
   b. removes moisture and impurities from system.
   c. cleans compressor out.
   d. makes easier charge system.

17. Why should you change oil in a compressor periodically?

   a. oil becomes rusty.
   b. oil will plug compressor.
   c. oil turns dark black.
   d. oil becomes contaminated.

18. To pull a deep vacuum, what should your micron gauge read?

   a. 1,000
   b. 2,000
   c. 3,000
   d. 300

19. How long should a vacuum be pulled on a system?

   a. 3 hours.
   b. 7 hours.
   c. depends on a wet or dry system.
   d. 1½ hours.

20. Name two (2) ways of checking a vacuum:

   a. with a manometer and set of gauges.
   b. with a manometer and micron gauge.
   c. with a micron gauge and manifold set.
   d. with a static gauge and manometer.

75.02.01.04 (continued)

21. What is used with a vacuum pump to see if you have a tight system?

    a. high vacuum manifold set.
    b. low vacuum manifold set.
    c. static pressure gauge.
    d. system analyzer.

22. What type of oil is used in a vacuum pump?

    a. any good non detergent oil.
    b. thirty (30) weight.
    c. vacuum pump oil.
    d. ten (10) weight.

23. Why must you be careful when charging a system to isolate the vacuum pump?

    a. refrigerant can damage pump.
    b. vacuum pump can suck oil out.
    c. may damage manifold set.
    d. may rupture a hose.

24. What is considered a complete vacuum?

    a. 29.2 inches mercury.
    b. 30.05 inches mercury.
    c. 38.95 inches mercury.
    d. 27.35 inches mercury.

25. How is a vacuum measured?

    a. pounds per square inch.
    b. in inches of mercury.
    c. in feet of mercury.
    d. in BTU's.

75.02.01.05

26. When is a charging cylinder used?

    a. to check a vacuum.
    b. to check for leaks.
    c. to measure charge.
    d. to drain a refrigeration system.

27. If you open the bottom valve you will get?

    a. liquid.
    b. gas.
    c. solids.
    d. neither.

75.02.01.05 (continued)

28. If you can not get a complete charge in a system, what do you use to force the rest of the refrigerant in with?

a. a vacuum pump.
b. a hi pressure pump.
c. a refrigerant expansion tool.
d. plug in a heater to build up pressure.

29. Name 2 types of refrigerant used in a charging cylinder:

a. refrigerant 709 and 803.
b. R 12 and R 22.
c. R 621 and R 704.
d. R 14 and R 29.

30. When charging a system that isn't running you charge from?

a. both hi and low sides.
b. just the high side.
c. just low side.
d. doesn't matter.

75.02.01.06

31. Viscosity is time in seconds it takes for a definite quantity of oil to flow through?

a. 100 degrees fahrenheit.
b. 100 degrees centigrade.
c. 70 degrees fahrenheit.
d. 211 degrees fahrenheit.

32. What is used to test oil for moisture content?

a. dialectric test.
b. moisture meter.
c. moisture indicator test.
d. hydroelectric test.

33. Can a person use carbon tetrochloride for cleaning?

a. yes.
b. no.
c. only on condensors.
d. only on vaporators.

34. What does cleaning solvent do?

a. remove moisture, oil, and grease sludge.
b. removes oil, grease, and any burrs in pipe.
c. removes oil sludge, grease and installation from windings.
d. removes oil sludge and all stoppages.

75.02.01.06 (continued)

35. What are gaskets used for?

    a. to hold joints together.
    b. to act as a cushion.
    c. seal joints between assembled parts.
    d. to prevent viberation.

75.02.01.07

36. What refrigerant is used as a good flushing agent?

    a. R-11
    b. R-12
    c. R-22
    d. R-113

37. What color can does refrigerant R-22 come in?

    a. white.
    b. green.
    c. blue.
    d. orange.

38. What is R-729?

    a. nitrogen.
    b. heleium.
    c. air.
    d. argon.

39. Refrigerant coming from service cylinder in a normal position comes out as:

    a. liquid.
    b. gas.
    c. combination.
    d. none of the above.

40. When you invert a refrigerant cylinder, refrigerant comes out as:

    a. liquid.
    b. gas.
    c. combination.
    d. low pressure.

75.02.01.08

41. Name something to tell customers on new installation?

    a. operation and guarantee.
    b. operation and how long it will last.
    c. guarantee and what problems to expect.
    d. what to fix if it breaks.

75.02.01.08

42. What do you first check on a service call?

    a. power cord.
    b. if cooling.
    c. customer complaint.
    d. refrigerant level.

43. What is the basic rule in customer relations?

    a. customer doesn't know what they are talking about.
    b. customer is always right.
    c. always be friendly and honest.
    d. tell customer what he wants to hear.

44. Why are inventory reports important?

    a. to check and see if employee is honest.
    b. to keep inventory up to date.
    c. to separate good from bad parts.
    d. avoid tax problems.

45. Why have call reports been surveyed?

    a. to see if employees are honest.
    b. to get a chance to talk to customers.
    c. to sell new products.
    d. to make sure service is completed properly and fairly.

46. Why are trucks equipped with CB radios?

    a. so the driver can have someone to talk with.
    b. for emergencies only.
    c. for rerouting.
    d. makes it easier to find directions.

47. What does an employer look for in an employee?

    a. someone that makes a lot of money.
    b. someone that knows refrigeration.
    c. minority.
    d. someone good and punctual.

48. What does an employee expect from his employer?

    a. lots of money.
    b. good medical and dental benefits.
    c. appreciation and chance to advance.
    d. paid sick pay.

75.02.01.08

49. What does a customer expect from a company?

    a. honest service and fair prices.
    b. fast service.
    c. cheap price.
    d. get the shaft.

50. Why do you want to work?

    a. to make money.
    b. to feed 6 kids and wife.
    c. to keep up with the Jones's.
    d. self satisfaction and accomplishment.

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UNIT PERFORMANCE TEST: REFRIGERATION TOOLS, MATERIALS AND REFRIGERENT

OBJECTIVE 1:

Measure and record temperatures in Fahrenheit and Centigrade using appropriate tools, equipment, and procedures.

OBJECTIVE 2:

Calculate in BTU's the amount of energy needed to do a specified amount of work.

OBJECTIVE 3:

Identify the major components on a simple refrigeration system (evaporator, compressor, condenser).

TASK:

Using appropriate tools, equipment and supplies, take and record temperatures in Fahrenheit and Centigrade. Also, define the BTU and identify the major components of a simple refrigeration system (evaporator, condenser, and compressor).

ASSIGNMENT:

CONDITIONS:

You will be completing the tasks listed in conditions similar to those of a simple refrigeration repair shop. You will be allowed to use any resource commonly available to serviceman; i.e., reference texts, manufacturer's specifications and directions. The tasks must be completed in the time listed without any assistance from the instructor or other students.

RESOURCES:

Printed Material:
Modern Refrigeration and Air Conditioning, Althouse

Equipment:
Work station which provides a drain (sink), a hot plate, and a container for water or refrigerant.

Tools:
1 Wide-necked thermos bottle
1 Tablespoon
1 Quart aluminum open topped can
1 Small beaker
1 Pair safety goggles

Instruments:
1 Glass-stemmed thermometer calibrated in degrees F.
1 Glass-stemmed thermometer calibrated in degrees C.
1 Dial thermometer
1 Recording thermometer

Supplies:
1 Carton crushed ice
1 Package rock salt (fine)
1 Package paper toweling
1 1-lb cylinder R-12

ASSIGNMENT SHEET: OBJECTIVE 1

JOB SHEET

[illegible]

[illegible]

1. Fill the thermos bottle with crushed ice and water. Stir.
2. Insert the two thermometers. Note and record the temperature.
3. Pour out the water. Add 2 tablespoons full of rock salt. Add some water and stir for at least 3 minutes.
4. Insert the two thermometers. Note and record the temperature.
5. Fill the one quart aluminum can about 3/4 full with warm water and place it on the hot plate.
6. Install the two thermometers in the can. Heat to boiling. Record the temperatures.
7. Add two tablespoons full of rock salt to the boiling water; be careful, it may boil over.
8. Repeat Step 6 above, using only some liquid R-12, instead of ice and water.

DATA:

	Stem Thermometer				Dial Thermometer				Rec. Thermometer		
	°F.	°C.	R	K	°F.	°C.	R	K	°F.	R	K
Ice water mixture											
Ice salt mixture											
Boiling salt water											
R-12											

Remarks:

ASSIGNMENT SHEET: OBJECTIVE 2

BTU PROBLEM SHEET

How much heat will be required to raise the temperature of 62.4 lbs (1 cubic ft) of water from 40^{o} F. to 80^{o} F?

How much heat must be removed to cool 50 lbs of water from 80^{o} F. to 35^{o} F?

Student: ____________________ **File Code:** 751.02.01.00

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PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory_____ Unsatisfactory_____

	CRITERION	
	Met	Not Met
Objective 1:		
1. Uses safe practices and procedures.		
Criterion: No injury or damage results to individual(s) or the		
equipment and complies with OSHA regulations.		
2. Uses appropriate tools, equipment, and procedures.		
Criterion: Complies to directions on Job Sheet 1-6 and the manufacturer's		
directions for use of the equipment.		
3. Accurately takes and records and calculates		
temperatures in Fahrenheit and Centigrade.		
Criterion: Temperatures are to ± 1% of the actual temperature.		
Objective 2:		
4. Accurately calculates the number of BTU's needed		
to do a specified amount of work.		
Criterion: Accurate to ± 2% of the total per instructor's key.		

	CRITERION	
	Met	Not Met
Objective 3:		
5. Accurate identification of components on a simple		
refrigeration system.		
Criterion: Complies to the information listed in the text, Modern		
Refrigeration and Air Conditioning, pp. 477-481 (Compressors),		
pp. 483-485 (Condensers), pp. 625-626 (Evaporators)		
6. Completes the job in a reasonable time.		
Criterion: Not to exceed 2-1/2 hours.		
The student must complete 5 of the 6 line items satisfactorily		
to complete this test. You cannot miss Item #6.		

INSTRUCTOR'S CRITERION KEY

Line Item 4:

Answer Key: Question 1 = 2496 BTU
Question 2 - 2250 BTU

LAP TEST ANSWER KEY: HAND TOOLS

1. B
2. A
3. B
4. A
5. C
6. A
7. C
8. A
9. C
10. B

LAP TEST ANSWER KEY: TORCH TIPS

1. B
2. D
3. B
4. A
5. A
6. C
7. A
8. D
9. D
10. A

LAP TEST ANSWER KEY: LEAK DETECTORS

1. A
2. C
3. C
4. B
5. C
6. C
7. A
8. A
9. C
10. C

LAP TEST ANSWER KEY: VACUUM PUMPS

1. B
2. D
3. D
4. C
5. B
6. A
7. C
8. A
9. A
10. B

LAP TEST ANSWER KEY: CHARGING CYLINDER

1. C
2. B
3. A
4. A
5. D
6. C
7. A
8. C
9.
10. A

LAP TEST ANSWER KEY:

1. D
2. A
3. B
4. A
5. B
6. C
7. A
8. A
9. C
10. B

LAP TEST ANSWER KEY: REFRIGERANTS AND PURPOSE

1. B
2. A
3. B
4. A
5. B
6. B
7. D
8. C
9. B
10. A

LAP TEST ANSWER KEY:

1.	A
2.	C
3.	B
4.	B
5.	D
6.	C
7.	D
8.	C
9.	A
10.	D

UNIT TEST ANSWER KEY: REFRIGERATION TOOLS, MATERIALS AND REFRIGERANT

LAP 01

1. B
2. B
3. A
4. A
5. C

LAP 02

6. B
7. D
8. B
9. D
10. A

LAP 03

11. A
12. B
13. C
14. A
15. C

LAP 04

16. B
17. D
18. D
19. C
20. B
21. A
22. C
23. A
24. A
25. B

LAP 05

26. C
27. A
28. D
29. ~~A~~ B
30. B

LAP 06

31. A
32. A
33. [illegible] B
34. A
35. C

LAP 07

36. A
37. B
38. C
39. B
40. A

LAP 08

41. A
42. C
43. B
44. B
45. D
46. C
47. D
48. C
49. A
50. D

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Learning Activity Package

Student: ________________

Date: ________________

PERFORMANCE ACTIVITY: ELECTRICITY

INTRODUCTION:

This LAP covers basic concepts or principles of electricity. The only prerequisite is to have read the Introductory Course and Unit Leg.

REVIEW:

Air conditioning systems have many electrical components. Some of these are: motors, switches, transformers, valves, and coils. To be a successful technician a knowledge of basic electricity is needed.

SKILL COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Explain what electricity is and where it comes from.
2. Demonstrate how and where to make electrical measurements.
3. Properly use appropriate test equipment.
4. Identify electrical parts and build a simple circuit.
5. Diagnose correctly selected electrical problems.
6. Answer written questions.

DISCUSSION:

Study the chapter in Getting Started in Heating and Air Conditioning Service, which covers basic electricity. Answer questions #1 through 32 at the end of the chapter.

Principal Author(s): John Carey

DEMONSTRATION:

Have your instructor demonstrate the use of experiment kit and test equipment.
CAUTION:

1. Use care in operating equipment.
2. Check for power before testing.

PERFORMANCE:

Obtain experiment procedure and follow carefully.

EVALUATION:

Notify the instructor when you want to take the written test. Have the instructor evaluate your performance test. All items should be accomplished successfully.

SUMMARY:

Go over the test with the instructor. You should now understand the following:

1. How to measure voltage and current.
2. How to check electrical circuits and components.
3. Proper care and use of test equipment.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ____________________ File Code: 751.02.02.01

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST: BASIC ELECTRICITY

1. What is electricity?

   a. electrons placed in series.
   b. form of residual power.
   c. electrons placed parallel.
   d. form of energy.

2. How do electrons move?

   a. slow.
   b. fast.
   c. negative to positive.
   d. positive to negative.

3. What are the requirements for a complete electrical circuit?

   a. source, load, conductor.
   b. volts, Amps. and resistance.
   c. volts, Ohms.
   d. Ohms and Amps.

4. What is the purpose of a fuse?

   a. protects fuse holder.
   b. protects wiring equipment.
   c. protects wiring and components.
   d. protects from wind damage.

5. How do you check a fuse to see if it is good?

   a. with AMP meter.
   b. with Volt meter.
   c. with Ohm meter.
   d. with a capacitor analyzer.

6. What is a step-down transformer?

   a. lowers voltage.
   b. raises voltage.
   c. triples voltage.
   d. sets lower in bracket.

7. What is a volt-ohmmeter used for?

   a. measures Amps and Ohms.
   b. measures volts and resistance.
   c. measures current and resistance.
   d. sets lower.

8. What is the first thing to do when checking resistance?

   a. turn control knob on.
   b. check voltage scale.
   c. zero meter.
   d. check battery pack.

9. How is an ammeter used?

   a. check Amps.
   b. resistance.
   c. volts.
   d. weight.

10. How many wires are there in 120v single phase power and how are they marked?

   a. 3, white, green, orange.
   b. 2, white and black.
   c. 3, white, black, red.
   d. 2, both black.

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Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: THERMOSTATS

INTRODUCTION:

This LAP covers thermostats, the different types used, how they work, and how to check them. The prerequisite is to have completed the previous LAP.

REVIEW:

Modern Heating and Refrigeration use thermostats for controlling the operation of electrical components. There is a wide variety of thermostats used, in different applications and service technicians need to know how they operate.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Describe how a thermostat operates.
2. Demonstrate how to check thermostats.
3. Answer written questions.

DISCUSSION:

Study the chapter in Getting Started in Heating and Air Conditioning Service, which covers thermostats and their uses. Answer questions #1 through 27 at the end of the chapter.

DEMONSTRATION:

NONE

PERFORMANCE:

Have your instructor give you a heating cooling thermostat. Read the installation and operating instructions. When you feel you understand it, install it on the heating trainer.

Principal Author(s): John Carey

EVALUATION:

Notify the instructor when you want to take the written test. Have your instructor evaluate your performance test. All items should be accomplished successfully.

SUMMARY:

Go over the test with the instructor. You should now understand the following:

1. Typical types of thermostats used for heating and cooling.
2. Installation needed for proper operation.
3. The different ways of checking a thermostat.

After successful completion of this LAP, record it on your SPR and proceed to the next LAP.

Student: ______________________ **File Code:** 751.02.02.02

Date: ______________________ **Date Published:** 12/5/77

Family Education Program

LAP TEST: THERMOSTATS

1. What are the main components of a thermostat?

   a. thermometer, dial and switches.
   b. thermometer, dial and wire.
   c. wire, dial and switches.
   d. screws, wire and dial.

2. How is a bimetal used?

   a. as a weight.
   b. as a spring.
   c. as a switch.
   d. as a hinge.

3. What is the delay in delivering air at the proper temperature called?

   a. start up time.
   b. heat up time.
   c. thermal inertia.
   d. lag time.

4. Is the heat anticipator in most thermostats adjustable?

   a. sometimes.
   b. all the time.
   c. never.
   d. most of the time.

5. How is a thermostat fastened to the wall?

   a. with screws in a level position.
   b. with nails in any position.
   c. screws so 70° on the dial is straight up.
   d. with screws in any position that customer wants.

6. When is the cooling anticipator energized?

   a. when the compressor is on.
   b. when compressor is off.
   c. all the time.
   d. when it is above 76° in the room.

7. When the cooling anticipator is energized, is there current through the compressor?

   a. sometimes.
   b. never.
   c. alot of current.
   d. small amount of current.

8. Why is cooling anticipation important?

   a. maintain current to thermostat.
   b. maintain even controlled room temperature.
   c. to keep ice from forming on evaporator.
   d. to help lower the room temperature faster.

9. Give the most usual designation for thermostat terminals, common, cooling, heating, and fan.

   a. white, yellow, red, green.
   b. blue, yellow, orange, green.
   c. white, yellow, red, blue.
   d. white, red, yellow, green.

10. Where would you mount a thermostat?

    a. near a register.
    b. in the sunlight.
    c. on an outside wall.
    d. in a living space 50" to 60" from floor.

11. What is a mercury switch used for?

    a. cycle blower.
    b. turn on resistance safety valve.
    c. cycle furnace.
    d. switch emergency resistance heat anticipation.

12. What cycles the furnace blower on heating?

    a. thermostat.
    b. gas valve.
    c. limit switch.
    d. fan switch.

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Learning Activity Package

Student: ______________

Date: ______________

PERFORMANCE ACTIVITY: HEATING FUNDAMENTALS

INTRODUCTION:

This LAP covers some basic heating fundamentals that a service technician needs to know to service heating equipment. The prerequisite is to have read and completed the previous LAP.

REVIEW:

To understand how a heating system works, there is a need to know heating fundamentals. There are several ways of transferring heat, and there are many ways to produce heat.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain some ways heat can be produced.
2. Explain some ways of transferring heat.
3. Explain how a typical heating system operates.
4. Identify components of a typical heating system.
5. Answer written questions about the above.

DISCUSSION:

Study the chapter in Getting Started in Heating and Air Conditioning. Answer questions 1 through 34 at the end of the chapter.

DEMONSTRATION:

Your instructor will explain and demonstrate "Firing Up", lighting and cycling the heating demonstrator.

Principal Author(s): John Carey

PERFORMANCE:

Under instructors supervision, identify the major components and their function in the operation of the heating system.

EVALUATION:

Tell your instructor when you are ready to take the written test. Have your instructor check over your performance test. All items must be accomplished successfully.

SUMMARY:

Go over the test with the instructor. You should now understand the following:

1. Ways in which heat can be produced.
2. Heat transfer techniques.
3. Components used to produce heat.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ File Code: 751.02.02.03

Date: ______________________ Date Published: Nov. 17,1977

Family Education Program

LAP TEST: HEATING FUNDAMENTALS

Unit 2: Lap 3

1. Heating is a form of?

   a. Force
   b. Energy
   c. Fuel
   d. Power

2. What is cold?

   a. Present of heating molecules
   b. Difference between heat and humidity
   c. The movement of cold molecules
   d. The absence of heat

3. What three (3) things must be present in order to have a flame?

   a. Fuel, Heat, Oxygen
   b. Heat, Oxygen, Water
   c. Fuel, Heat, Propane
   d. Blower, Heat Exchange, and Fuel

4. What are the products combustion?

   a. Oxygen, Carbon
   b. Hydrogen, Carbon
   c. Nitrogen, Oxygen, Carbon
   d. CO^2, H^2O plus Nitrogen

5. How many cubic feet of air does it take to produce 1000 BTU'S of heat?

   a. 12 cubic feet of air
   b. 7 cubic feet of air
   c. 10 cubic feet of air
   d. 20 cubic feet of air

6. What are the products of incomplete combustion?

   a. CO^2, H^2O, and Soot
   b. H^2O, CO
   c. Soot and CO
   d. CO^2, H^2O, CO, and Soot

7. What percent of the furnace is used to heat the house?

   a. 90%
   b. 80%
   c. 75%
   d. 95%

8. What is the problem of a cold chimney?

   a. Condensation
   b. Nameration
   c. Partial heating
   d. Overdraft

9. What is the purpose of the heating exchanger?

   a. Seperate the hot from the cold
   b. Transfer heat, conduction and radiation
   c. Remove unwanted heat
   d. Exchange heat from dirty air to particles

10. What are three (3) methods of transferring heat?

   a. Conduction, convection, radiation
   b. The sun, heat exchangerm blower
   c. Blower, heat exchanger, circulatory pump
   d. Sun light, heat waver, convection

File Code: 751.02.02.04

Date Published: 11/14/77

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Learning Activity Package

Student: ____________

Date: ____________

PERFORMANCE ACTIVITY: HEATING COMPONENTS

INTRODUCTION:

This LAP covers major components used on a typical heating system. The prerequisite is to have completed the previous LAP.

REVIEW:

The average heating system has several components needed for safe dependable operation. A service technician must become familiar with these components, understand how they work, and how to change them.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Identify components on a typical heating system.
2. Properly operate and cycle a typical furnace.
3. Replace components.
4. Answer written questions.

DISCUSSION:

Study the chapter in Getting Started in Heating and Air Conditioning Service. Answer questions 1 through 17.

DEMONSTRATION:

Have the instructor fire up the heating trainer. Go over the operation of the furnace.

PERFORMANCE:

Under strict supervision by the instructor, you will fire the system.

Principal Author(s): John Carey

EVALUATION:

Tell your instructor when you are ready to take the written test. Have your instructor check over your performanne test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. How to troubleshoot the system.
2. How to change components.
3. Function of the major components.
4. How to identify the major components.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ **File Code:** 751.02.02.04

Date: ______________________ **Date Published:** Nov. 17,1977

Family Education Program

LAP TEST: HEATING COMPONENTS

1. Name the two (2) basic types of blowers.

   a. High and low speed
   b. Forward and reverse
   c. Direct drive and belt drive
   d. Centrifical receparating

2. What are two (2) types of filters?

   a. Throw away and permanent
   b. Square and rectangular
   c. Fiberglass and plastic
   d. Lefthand and righthand

3. What is the purpose of the blower?

   a. Air and combustion
   b. Blow the gas into the system
   c. Reduce static pressure
   d. Move the air throughout the system

4. What test equipment do you use to check current on a motor?

   a. Volt meter
   b. Multimeter
   c. Amp meter
   d. Milli volt meter

5. A limit control is?

   a. Safety device
   b. Speed control
   c. Safety valve
   d. A gas pressure valve

6. What temperature is a limit control set at?

   a. 180 degrees
   b. 200 degrees
   c. 220 degrees
   d. 175 degrees

7. What is the purpose of a fan control?

   a. Cycle the blower
   b. Shut off the gas valve
   c. Turns on the gas valve
   d. Acts as a safety switch

8. On the heat cycle is the motor set on high or low speed?

   a. Dosen't matter what speed
   b. On a heat pump, (would be low speed)
   c. Low speed
   d. High speed

9. How do you change speed on the blower, on a belt drive system?

   a. Get a bigger squirrel cage
   b. Adjust the variable speed pulley
   c. Turn the motor around
   d. Tighten the belt

10. Where are the major components located on a furnace?

   a. In the cabinet
   b. In the plenuim
   c. In the heat exchanger
   d. In the blower cabinet

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Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: GAS HEATING

INTRODUCTION:

This LAP covers the typical gas residential heating system. The only prerequisite is to have read and completed the previous LAP.

REVIEW:

Gas fired furnaces are used in many home heating systems. They are safe, economical units when installed and operated properly.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Replace components.
2. Give efficiency check.
3. Check unit for safe operation.

DISCUSSION:

Study the chapter in Getting Started in Heating and Air Conditioning Service (Allan Russell). Answer questions 1 through 32 at the end of the chapter. Study the chapter in Modern Refrigeration and Air Conditioning covering gas systems.

DEMONSTRATION:

NONE

PERFORMANCE:

Remove gas valve, manifold and burner assembly, go over parts and operation with the instructor.

Principal Author(s): John Carey

EVALUATION:

Tell your instructor when you are ready to take the written test. Have your instructor check over your performance test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. Operation of a gas furnace.
2. How to troubleshoot components.
3. How to change components.

After successful completion, record the LAP on SPR and proceed to the next LAP.

Student: ____________________ File Code: 751.02.02.05

Date: ____________________ Date Published: 12/5/77

Family Education Program

LAP TEST: GAS HEATING

1. How many clamshells are there in a 3 burner furnace?

   a. 1
   b. 2
   c. 3
   d. 4

2. How is primary air adjusted?

   a. with a damper.
   b. draft diverter.
   c. shuttle.
   d. squirrel cage.

3. What feeds gas into burners?

   a. muffler.
   b. manifold.
   c. supply tube.
   d. cross lighter.

4. What is the purpose of a crosslighter?

   a. light burners at same time.
   b. divert pilot light.
   c. relight pilot.
   d. cross over thermocouple.

5. What is used to check gas pressure on a furnace?

   a. water diverter.
   b. draft gauge.
   c. thermo gauge.
   d. water gauge.

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File Code: 751.02.02.06

Date Published: 11/14/77

Learning Activity Package

Student: ________________

Date: ________________

PERFORMANCE ACTIVITY: OIL HEATING

INTRODUCTION:

This LAP covers the typical oil fired heating system. The prerequisite is to have read and completed the previous LAP.

REVIEW:

Oil fired systems are used a lot in the country, where natural gas isn't available. Oil systems can be very satisfactory when properly installed and maintained.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Check for safe operation of the unit.
2. Give efficiency checks.
3. Diagnose problems.
4. Change defective components.

DISCUSSION:

Study chapter 6 in Getting Started in Heating and Air Conditioning Service (Allan Russell). Answer questions 1 through 35 at the end of the chapter. Also study the chapter in Modern Refrigeration and Air Conditioning covering oil fired systems.

DEMONSTRATION:

Have the instructor fire up the oil fired system. Go over the operating procedures with him.

Principal Author(s): John Carey

PERFORMANCE:

Completely remove all major components of the system. Go over all parts with the instructor. Reassemble the system when you feel you know how everything operates. Get a combustion test kit from the tool room. Go over the operating procedure of the test kit twice. When you feel you understand how to use it, give the furnace an efficiency check. During all check-out procedures, make sure an instructor is present. At any time while working with the oil system and you have a problem, make sure you see an instructor before proceeding further. If you feel confident in your work, continue on in the LAP. If not, repeat your performance part of the LAP.

EVALUATION:

Tell your instructor when you are ready to take the written test. Have your instructor check over your performance test. All items should be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. How a typical oil fired furnace operates.
2. How to troubleshoot systems.
3. How to give efficiency checks.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ **File Code:** 751.02.02.06

Date: ______________________ **Date Published:** 11/17/77

Family Education Program

LAP TEST: OIL HEATING

1. What type of fuel oil is used in most domestic oil burners?

    a. number 4 fuel oil.
    b. number 3 fuel oil.
    c. number 2 fuel oil.
    d. number 10 fuel oil.

2. When is a two pipe system used?

    a. when the vertical lift exceeds 8 feet.
    b. when the vertical lift exceeds 15 feet.
    c. when the vertical lift exceeds 3 feet.
    d. when the vertical lift exceeds 2 foot.

3. How many heating surfaces does the oil heat exchanger have?

    a. 4
    b. 2
    c. 3
    d. 5

4. The safety control and flame detection circuit for an oil burner are both enclosed in what is called:

    a. secondary control.
    b. low voltage control.
    c. primary control.
    d. ban limit control.

5. In an oil burner system what is used to determine whether or not ignition has been accomplished?

    a. a flame detector.
    b. a noise detector.
    c. a safety limit switch.
    d. a fan switch.

6. In a gun-type oil burner the oil is:

    a. heated up.
    b. automatized.
    c. pressurized.
    d. electrified.

7. The transformer is capable of putting out how many volts?

    a. 3600
    b. 4900
    c. 8700
    d. 10,000

8. What does a fuel nozzle do?

    a. atomize, give fuel delivery, and form a pattern.
    b. atomize, give fuel delivery, and heat the fuel.
    c. heat the fuel, give delivery, and pressurize the fuel.
    d. heat the fuel, clean the fuel, and vaporize the fuel.

9. What is the pump pressure usually set at?

    a. 95 pounds.
    b. 65 pounds.
    c. 100 pounds.
    d. 125 pounds.

10. What does a service technician use for checking an oil system for efficiency?

    a. a volacity test kit.
    b. a combustion test kit.
    c. a U2 vonimeter.
    d. a smoke gun.

File Code: 751.02.02.07

Date Published: 11/14/77

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: ELECTRIC HEATING

INTRODUCTION:

This LAP covers the typical electric heating system. The prerequisite is to have read and completed the previous LAP.

REVIEW:

Electric systems are becoming more popular as the price of fossil fuels keep going up. Electric heat is safe, clean, efficient, and easy to work on, when properly installed and maintained.

SKILL COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Diagnose systems failure.
2. Change defective components.

DISCUSSION:

Study the chapter on Electric Heating in Getting Started in Heating and Air Conditioning. Answer questions 1 through 9 at the end of the chapter.

DEMONSTRATION:

Have the instructor go over operation of a furnace.

PERFORMANCE:

Check to see if the power is off. Disassemble the furnace, removing only major components. Go over the operation of the components with the instructor. Reassemble the system, then turn it on and check for proper operation. When you feel confident that you understand how it operates, proceed on. If you don't, ask for some help from your instructor.

Principal Author(s): John Carey

EVALUATION:

Tell your instructor when you are ready to take the written test. Have your instructor check over your performance test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. How a typical electrical heating system operates.
2. Function of the components.
3. Procedures for changing components.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ____________________ File Code: 751.02.02.07

Date: ____________________ Date Published: Nov. 18,1977

Family Education Program

LAP TEST: ELECTRIC HEATING

1. Why is electric heat becoming more and more popular?

   a. due to the shortage of natural gas
   b. because of low cost of electricity
   c. it's easier to work on
   d. electricity gives better efficient heating

2. Does an electric furnace have a heat exchanger?

   a. only on large commercial units
   b. a heat exchanger is not needed
   c. all electric furnaces have heat exchangers
   d. only on resistance heating element electric furnaces

3. How many BTU's are on in one kilowatt of electrical heat?

   a. 5,000 BTU's
   b. 3,415 BTU's
   c. 6,800 BTU's
   d. 2,415 BTU's

4. Why do we step start the heating elements in large electric furnaces?

   a. they heat up faster
   b. it's easier on the unit and won't overload the circuit
   c. it heats up slower
   d. it's not as noisy

5. How many limit controls are on electric furnace?

   a. 3
   b. 6
   c. only 1
   d. 1 for each element

6. At what temperature is thermal fuse set to open?

   a. 600 to 610 degrees
   b. 300 to 310 degrees
   c. 200 to 210 degrees
   d. 350 to 360 degrees

7. How efficient is an electric furnace?

   a. 100% efficient
   b. 90% efficient
   c. 80% efficient
   d. 97% efficient

8. What is the usual voltage of an electric furnace?

   a. 110 volts
   b. 220 volts
   c. 240 volts
   d. 440 volts

9. For an electric furnace, what should the temperature rise be?

   a. from 70 to 90 degrees
   b. from 90 to 110 degrees
   c. from 50 to 70 degrees
   d. from 95 to 135 degrees

10. When does the fan come on in an electric furnace?

   a. slightly ahead or at the same time as the first element
   b. 30 seconds after the first element has started to heat up
   c. 2 minutes before the heating element comes on
   d. 3 minutes after the element has come on

Family Education Program

File Code: 751.02.02.08

Date Published: 11/4/77

Learning Activity Package

Student: __________

Date: __________

PERFORMANCE ACTIVITY: COOLING FUNDAMENTALS

INTRODUCTION:

This LAP covers the cooling fundamentals of central air conditioning. The only prerequisite is to have read and completed the previous LAP.

REVIEW:

In order to have a complete total comfort system which maintains uniform temperature year round, it is necessary to have cooling equipment to remove the heat gained during the summer months. A good service technician needs to understand and be able to service cooling systems.

COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Explain how a central air conditioning unit operates.
2. Diagnose problems.
3. Repair system malfunctions.

ASSIGNMENT:

Study Chapter 8 in Getting Started in Heating and Air Conditioning Service, (Allan Russell). Answer questions 1 through 21 at the end of the chapter.

WRITTEN EVALUATION:

When you have completed the assigned material, take the written test. Upon successful completion, proceed to demonstration.

DEMONSTRATION:

Have your instructor run the air conditoner trainer. Go over operations with him.

PERFORMANCE:

If you understand the safe operating procedures for running the unit, ask your instructor for approval to operate the trainer. Go over the operation of the unit.

Principal Author(s): John Carey

Family Training Center, Inc.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor check over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. How heat is removed from an air conditioned area.
2. What a central air conditioner does.
3. How it does it.

After successful completion, record the LAP on SPR and proceed to the next LAP.

Student: ____________________ File Code: 751.02.02.08

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST: COOLING FUNDAMENTALS

1. What does an air conditioner do besides remove heat?

   a. humidify.
   b. dehumidify.
   c. clean the air.
   d. remove smoke.

2. What is used to measure heat?

   a. a thermometer.
   b. hydrometer.
   c. amprobe.
   d. manometer.

3. Can laden heat be measured with a thermometer?

   a. only on days with heavy humidity.
   b. no.
   c. yes, at any time.
   d. only with a Taylor thermometer.

4. What takes place during a change of state?

   a. a substance goes from liquid to solid.
   b. a substance gets hotter.
   c. a substance gets cooler.
   d. nothing happens.

5. What is a British thermal unit?

   a. air moving in one direction and resistance to the air movement.
   b. the amount of heat used to raise one pound of water one degree F.
   c. the amount of heat it takes to raise one cubic foot of water one degree F.
   d. the amount of heat that is removed from one cubic foot of water one degree F.

6. What do you use to measure sensible heat?

   a. hydrometer.
   b. a thermometer.
   c. a heat sensing gauge.
   d. a barometer.

7. How can you change the boiling temperature of water?

   a. by increasing the pressure.
   b. by decreasing the heat.
   c. by decreasing the pressure.
   d. by holding a constant pressure in a confined container.

8. Why is R22 used instead of R12 in air conditioning systems?

   a. it has a much higher laden heat of evaporation.
   b. it costs less.
   c. it's safer to use.
   d. it isn't affected by pressure.

9. Can you use the temperature of refrigerant to find the pressure at which the refrigerant is at?

   a. yes, your pressure corresponds to your temperature.
   b. no.
   c. only when using refrigerant 22.
   d. only when using refrigerant 12.

10. What is cooling?

   a. the removal of heat from the air stream.
   b. the adding of cooling or cold air to the air stream.
   c. the evaporation of warm air.
   d. the condensation of warm air.

11. What is the state of the refrigerant as it leaves the condenser?

   a. a vapor.
   b. a liquid.
   c. a low pressure vapor.
   d. a high pressure vapor.

12. What is the state of the refrigerant as it leaves the evaporator?

   a. a high pressure liquid.
   b. a high pressure vapor.
   c. a vapor.
   d. a liquid.

13. What happens to the refrigerant as it goes through the metering device?

   a. the pressure increases.
   b. the pressure doesn't change.
   c. it changes state.
   d. the vapor changes to a liquid.

14. What does the compressor do?

    a. separates the filter from the evaporator.
    b. separates the condenser from the evaporator.
    c. compresses refrigerant gas.
    d. compresses refrigerant liquid.

15. What is another name for laden heat?

    a. unmeasured heat.
    b. hidden heat.
    c. exact heat.
    d. high pressure heat.

File Code: 751.02.02.09

Date Published: 11/4/77

Family Education Program

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: COOLING COMPONENTS

INTRODUCTION:

This LAP covers cooling components used in a typical central air conditioner. The only prerequisite is to have read and completed the previous LAP.

REVIEW:

Before a service technician can service a central air conditioner, he must first know what components there are and what they do in a typical system.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Diagnose components failure.
2. Replace major components.

ASSIGNMENT:

Study Chapter 9 in Getting Started in Heating and Air Conditioning Service. Answer questions 1 through 31 at the end of the chapter.

WRITTEN EVALUATION:

When you complete the assignment and feel you understand the material, take the written test. Upon successful completion, continue.

DEMONSTRATION:

Get the instructor to help if you have any trouble.

PERFORMANCE:

Go to the central air trainer, remove all major components, other than the sealed system components. Make sure you understand how everything operates and how they are removed and installed.

Principal Author(s): John Carey

EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor check over your Performance Test. All items should be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. How a typical central air conditioner operates.
2. How the components are used.
3. How to diagnose component failures.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ **File Code:** 751.02.02.09

Date: ______________________ **Date Published:** 11/17/77

Family Education Program

LAP TEST: COOLING COMPONENTS

1. What is the most important part of a sealed system?

    a. the condenser.
    b. the evaporator.
    c. the compressor.
    d. the metering device.

2. What is it called when a system is shut off and the refrigerant condenses into a liquid and returns to the compressor?

    a. migration.
    b. frost back.
    c. flood back.
    d. low pressure accumulation.

3. What is used to cool the compressor in a sealed system?

    a. the refrigerant vapor.
    b. refrigerant as a liquid.
    c. moisture in the refrigerant.
    d. 30 weight used in the system.

4. What is used to prevent migration?

    a. a heat lamp.
    b. crankcase heater.
    c. cycle in the compressor.
    d. a defrost heater timer.

5. What is the purpose of the condenser?

    a. to remove unwanted oil from the system.
    b. to remove heat from the refrigerant.
    c. to increase the pressure of the refrigerant.
    d. to change the refrigerant from a liquid to a vapor.

6. What are the two purposes of an evaporator?

    a. remove moisture content and reduce the temperature.
    b. remove moisture content and increase the refrigerant pressure.
    c. change the refrigerant from a liquid to a vapor and add humidity.
    d. add humidity and increase high side pressure.

7. Name 3 types of evaporator coils used in a central air conditioner.

   a. flat coil, A coil, and slant coil.
   b. flat coil, slant coil and round coil.
   c. round coil, square coil and A coil.
   d. A coil, slant coil and reverse coil.

8. What is the purpose of a dryer?

   a. to dry out the refrigerant through increased pressure.
   b. to dry the oil from the system.
   c. remove both solids and undesirable soluables.
   d. defrost the evaporator.

9. Why is one reason capillary tubes have come into wide spread use?

   a. its reliability.
   b. its costs.
   c. it's easy to install.
   d. it's easy to troubleshoot a capillary tube system.

10. How do you measure super heat?

   a. with a electronic super heat thermometer.
   b. by measuring the temperature of the inlet and outlet of the evaporator.
   c. by measuring across the condenser and the evaporator.
   d. by using a super heat thermal gauge.

Family Education Program

File Code: 751.02.02.10

Date Published: 11/4/77

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: COOLING INSTALLATION

INTRODUCTION:

This LAP covers the installation of a central air conditioning system. The only prerequisite is to have read and completed the previous LAP.

REVIEW:

A service technician is often called upon to install or modify central air conditioning systems. A knowledge of proper installation is also needed to service existing units. Frequently, problems are a result of poor installation.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Properly install a central air conditioner.
2. Diagnose problems related to incorrectly installed systems.
3. Check air flow across coil (static pressure using water gauge and manometer).

ASSIGNMENT:

Study Chapter 10 in Getting Started In Heating and Air Conditioning Service, (Allan Russell). Answer questions 1 through 48 at the end of the chapter.

WRITTEN EVALUATION:

When you have completed the assignment, take the written test. Upon successful completion, continue.

DEMONSTRATION:

Ask the instructor to help if you have a problem.

Principal Author(s): John Carey

Family Training Center, Inc.

PERFORMANCE:

Install central air conditioner in heating trainer. Check for the following: proper locations, condenser oil trap on line, proper lines and routing, proper evaporator, proper locations of evaporator, proper blower size, right rotation of motor, right HP rating, proper supply and return size, balanced system, proper sized system for area it is handling, filter, condensation trap, condensation drain, static pressure, properly wired and fused, and most of all, proper operation procedure. After installation, check voltage and current draw. Have the instructor go over the installation with you.

PERFORMANCE EVALUATION:

Tell your instructor you are ready to take the Performance Test. Have your instructor check over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor, you should now understand the following:

1. How a central air conditioner is properly installed.
2. How a system is checked for performance.
3. Proper operation of a central air conditioner.

After successful completion, record LAP on SPR. Have your instructor give you a Unit Test and a unit Performance Test. After successful completion of your test, proceed to the next Unit.

Student: ____________________ File Code: 751.02.02.10

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST: COOLING INSTALLATIONS

1. What is a split system central air conditioner?

   a. when the evaporator is split in two sections.
   b. when the condenser is split in two sections.
   c. when the evaporator is housed in one cabinet and the condenser is housed in another cabinet.
   d. when the condenser sits on top of the evaporator.

2. Where is the evaporator located in a central air conditioning system?

   a. in the furnace planum.
   b. along side the condenser.
   c. in the heat exchanger.
   d. in the blower cabinet.

3. Where is the condenser located?

   a. on the south side of the house.
   b. under a shady tree.
   c. in the basement in a cool location.
   d. on the north side preferably on a concrete slab.

4. Where would an oil trap be located?

   a. in the suction line.
   b. in the liquid line.
   c. in the high pressure release line.
   d. in the low pressure release line.

5. When is an oil trap installed?

   a. when the evaporator is ten feet or more below the compressor.
   b. when the evaporator is ten feet or more above the compressor.

   c. when the evaporator is six feet or more below the compressor.
   d. when the evaporator is twelve feet above the compressor.

b. when the evaporator is ten feet or more above the compressor.
c. when the evaporator is six feet or more below the compressor.
d. when the evaporator is twelve feet above the compressor.

7. After installing your lines on a central air conditioner, what do you do?

   a. check all joints for leaks.
   b. check for frost on the condensation line.
   c. check for extreme heat on your high sides.
   d. check for impingement of the filter screens.

8. What do you apply to all oil rings when hooking up your pre-charged tubing?

   a. silicone grease.
   b. refrigeration oil.
   c. high detergent oil.
   d. vaseline.

9. When wiring the system up, where do you place your main disconnect switch?

   a. in the basement close to the evaporator.
   b. along side the main furnace control.
   c. outside near your meter loop.
   d. on the condenser unit.

10. How many volts is your thermostat operated with in most cases?

   a. 120 volts AC.
   b. 24 volts.
   c. 120 volts DC.
   d. 36 volts.

Student: ______________________ **File Code:** 751.02.02.00

Date: ______________________ **Date Published:** 12/5/77

Family Education Program

UNIT TEST: BASIC HEATING & AIR CONDITIONING

75.02.02.01

1. What is electricity?

   a. electrons placed in series.
   b. form of residual power.
   c. electrons placed parallel.
   d. form of energy.

2. How do electrons move?

   a. slow.
   b. fast.
   c. negative to positive.
   d. positive to negative.

3. What are the requirements for a complete electrical circuit?

   a. source, load, conductor.
   b. volts, amps. and resistance.
   c. volts, ohms.
   d. ohms and amps.

4. What is the purpose of a fuse?

   a. protects fuse holder.
   b. protects wiring equipment.
   c. protects wiring and components.
   d. protects from wind damage.

5. How do you check a fuse to see if it is good?

   a. with amp meter.
   b. with volt meter.
   c. with ohm meter.
   d. with a capacitor analyzer.

6. What is a step-down transformer?

   a. lowers voltage.
   b. raises voltage.
   c. triples voltage.
   d. sets lower in bracket.

75.02.02.01 (continued)

7. What is a volt-ohmmeter used for?

   a. measures amps and ohms.
   b. measures volts and resistance.
   c. measures current and resistance.
   d. sets lower.

8. What is the first thing to do when checking resistance?

   a. turn control knob on.
   b. check voltage scale.
   c. zero meter.
   d. check battery pack.

9. How is an ammeter used?

   a. check amps.
   b. resistance.
   c. volts.
   d. weight.

10. How many wires are there in 120v single phase power and how are they marked?

   a. 3, white, green, orange.
   b. 2, white and black.
   c. 3, white, black, red.
   d. 2, both black.

75.02.02.02

11. What are the main components of a thermostat?

   a. thermometer, dial and switches.
   b. thermometer, dial and wire.
   c. wire, dial and switches.
   d. screws, wire and dial.

12. How is a bimetal used?

   a. as a weight.
   b. as a spring.
   c. as a switch.
   d. as a hinge.

13. What is the delay in delivering air at the proper temperature called?

   a. start up time.
   b. heat up time.
   c. thermal inertia.
   d. lag time.

75.02.02.02 (continued)

14. Is the heat anticipator in most thermostats adjustable?

    a. sometimes.
    b. all the time.
    c. never.
    d. most of the time.

15. How is a thermostat fastened to the wall?

    a. with screws in a level position.
    b. with nails in any position.
    c. screws so 70° on the dial is straight up.
    d. with screws in any position that customer wants.

75.02.02.03

16. Heating is a form of?

    a. force.
    b. energy.
    c. fuel.
    d. power.

17. What is cold?

    a. present of heating molecules.
    b. difference between heat and humidity.
    c. the movement of cold molecules.
    d. the absence of heat.

18. What three (3) things must be present in order to have a flame?

    a. fuel, heat, oxygen.
    b. heat, oxygen, water.
    c. fuel, heat, propane.
    d. blower, heat exchange, and fuel.

19. What are the products combustion?

    a. oxygen, carbon.
    b. hydrogen, carbon.
    c. nitrogen, oxygen, carbon.
    d. $c0^2$, H^20 plus nitrogen.

20. How many cubic feet of air does it take to produce 1000 BTU's of heat?

    a. 12 cubic feet of air.
    b. 7 cubic feet of air.
    c. 10 cubic feet of air.
    d. 20 cubic feet of air.

75.02.02.03 (continued)

21. What are the products of incomplete combustion?

- a. CO^2, H^2O, and soot.
- b. H^2O, CO.
- c. soot and CO.
- d. CO^2, H^2O, CO, and soot.

22. What percent of the furnace is used to heat the house?

- a. 90%
- b. 80%
- c. 75%
- d. 95%

23. What is the problem of a cold chimney?

- a. condensation.
- b. nameration.
- c. partial heating.
- d. overdraft.

24. What is the purpose of the heating exchanger?

- a. separate the hot from the cold.
- b. transfer heat, conduction and radiation.
- c. remove unwanted heat.
- d. exchange heat from dirty air to particles.

25. What are the three (3) methods of transferring heat?

- a. conduction, convection, radiation.
- b. the sun, heat exchanger, blower.
- c. blower, heat exchanger, circulatory pump.
- d. sun light, heat waver, convection.

75.02.02.04

26. Name the two (2) basic types of blowers.

- a. high and low speed.
- b. forward and reverse.
- c. direct drive and belt drive.
- d. centrifugal receparating.

27. What is the purpose of the blower?

- a. air and combustion.
- b. blow the gas into the system.
- c. reduce static pressure.
- d. move the air throughout the system.

75.02.02.04 (continued)

28. A limit control is?

- a. safety device.
- b. speed control.
- c. safety valve.
- d. a gas pressure valve.

29. What temperature is a limit control set at?

- a. 180 degrees.
- b. 200 degrees.
- c. 220 degrees.
- d. 175 degrees.

30. How do you change speed on the blower, on a belt drive system?

- a. get a bigger squirrel cage.
- b. adjust the variable speed pulley.
- c. turn the motor around.
- d. tighten the belt.

75.02.02.05

31. How many clamshells are there in a 3 burner furnace?

- a. 1
- b. 2
- c. 3
- d. 4

32. How is primary air adjusted?

- a. with a damper.
- b. draft diverter.
- c. shuttle.
- d. squirrel cage.

33. What feeds gas into burners?

- a. muffler.
- b. manifold.
- c. supply tube.
- d. cross lighter.

34. What is the purpose of a crosslighter?

- a. light burners at same time.
- b. divert pilot light.
- c. relight pilot.
- d. cross over thermocouple.

75.02.02.05 (continued)

35. What is used to check gas pressure on a furnace?

    a. water diverter.
    b. draft gauge.
    c. thermo gauge.
    d. water gauge.

75.02.02.06

36. What type of fuel oil is used in most domestic oil burners?

    a. number 4 fuel oil.
    b. number 3 fuel oil.
    c. number 2 fuel oil.
    d. number 10 fuel oil.

37. When is a two pipe system used?

    a. when the vertical lift exceeds 8 feet.
    b. when the vertical lift exceeds 15 feet.
    c. when the vertical lift exceeds 3 feet.
    d. when the vertical lift exceeds 2 foot.

38. In an oil burner system, what is used to determine whether or not ignition has been accomplished?

    a. a flame detector.
    b. a noise detector.
    c. a safety limit switch.
    d. a fan switch.

39. The transformer is capable of putting out how many volts?

    a. 3600
    b. 4900
    c. 8700
    d. 10,000

40. What does a fuel nozzle do?

    a. atomize, give fuel delivery, and form a pattern.
    b. atomize, give fuel delivery, and heat the fuel.
    c. heat the fuel, give delivery, and pressurize the fuel.
    d. heat the fuel, clean the fuel, and vaporize the fuel.

75.02.02.07

41. Does an electric furnace have a heat exchanger?

    a. only on large commercial units.
    b. a heat exchanger is not needed.
    c. all electric furnaces have heat exchangers.
    d. only on resistance heating element electric furnaces.

75.02.02.07 (continued)

42. Why do we step start the heating elements in large electric furnaces?

    a. they heat up faster.
    b. it's easier on the unit and won't overload the circuit.
    c. it heats up slower.
    d. it's not as noisy.

43. At what temperature is thermal fuse set to open?

    a. 600 to 610 degrees.
    b. 300 to 310 degrees.
    c. 200 to 210 degrees.
    d. 350 to 360 degrees.

44. For an electric furnace, what should the temperature rise be?

    a. from 70 to 90 degrees.
    b. from 90 to 110 degrees.
    c. from 50 to 70 degrees.
    d. from 95 to 135 degrees.

45. When does the fan come on in an electric furnace?

    a. slightly ahead or at the same time as the first element.
    b. 30 seconds after the first element has started to heat up.
    c. 2 minutes before the heating element comes on.
    d. 3 minutes after the element has come on.

75.02.02.08

46. What does an air conditioner do besides remove heat?

    a. humidify.
    b. dehumidify.
    c. clean the air.
    d. remove smoke.

47. What is used to measure heat?

    a. a thermometer.
    b. hydrometer.
    c. amprobe.
    d. manometer.

48. Can laden heat be measured with a thermometer?

    a. only on days with heavy humidity.
    b. no.
    c. yes, at any time.
    d. only with a Taylor thermometer.

75.02.02.08 (continued)

49. What takes place during a change of state?

  a. a substance goes from liquid to solid.
  b. a substance gets hotter.
  c. a substance gets cooler.
  d. nothing happens.

50. What is a British thermal unit?

  a. air moving in one direction and resistance to the air movement.
  b. the amount of heat used to raise one pound of water one degree F.
  c. the amount of heat it takes to raise one cubic foot of water one degree F.
  d. the amount of heat that is removed from one cubic foot of water one degree F.

51. What do you use to measure sensible heat?

  a. hydrometer.
  b. a thermometer.
  c. a heat sensing gauge.
  d. a barometer.

52. How can you change the boiling temperature of water?

  a. by increasing the pressure.
  b. by decreasing the heat.
  c. by decreasing the pressure.
  d. by holding a constant pressure in a confined container.

53. Why is R22 used instead of R12 in air conditioning systems?

  a. it has a much higher laden heat of evaporation.
  b. it costs less.
  c. it's safer to use.
  d. it isn't affected by pressure.

54. Can you use the temperature of refrigerant to find the pressure at which the refrigerant is at?

  a. yes, your pressure corresponds to your temperature.
  b. no.
  c. only when using refrigerant 22.
  d. only when using refrigerant 12.

55. What is cooling?

  a. the removal of heat from the air stream.
  b. the adding of cooling or cold air to the air stream.
  c. the evaporation of warm air.
  d. the condensation of warm air.

75.02.02.09

56. What is it called when a system is shut off and the refrigerant condenses into a liquid and returns to the compressor?

   a. migration.
   b. frost back.
   c. flood back.
   d. low pressure accumulation.

57. What is used to cool the compressor in a sealed system?

   a. the refrigerant vapor.
   b. refrigerant as a liquid.
   c. moisture in the refrigerant.
   d. 30 weight used in the system.

58. Name 3 types of evaporator coils used in a central air conditioner?

   a. flat coil, A coil and slant coil.
   b. flat coil, slant coil and round coil.
   c. round coil, square coil and A coil.
   d. A coil, slant coil and reverse coil.

59. What is the purpose of a dryer?

   a. to dry out the refrigerant through increased pressure.
   b. to dry the oil from the system.
   c. remove both solids and undesirable soluables.
   d. defrost the evaporator.

60. How do you measure super heat?

   a. with a electronic super heat thermometer.
   b. by measuring the temperature of the inlet and outlet of the evaporator.
   c. by measuring across the condenser and the evaporator.
   d. by using a super heat thermal gauge.

75.02.02.10

61. What is a split system central air conditioner?

   a. when the evaporator is split in two sections.
   b. when the condenser is split in two sections.
   c. when the evaporator is housed in one cabinet and the condenser is housed in another cabinet.
   d. when the condenser sits on top of the evaporator.

62. Where is the evaporator located in a central air conditioning system?

   a. in the furnace planum.
   b. along side the condenser.
   c. in the heat exchanger.
   d. in the blower cabinet.

75.02.02.10 continued

63. Where is the condenser located?

    a. on the south side of the house.
    b. under a shady tree.
    c. in the basement in a cool location.
    d. on the north side preferably on a concrete slab.

64. Where would an oil trap be located?

    a. in the suction line.
    b. in the liquid line.
    c. in the high pressure release line.
    d. in the low pressure release line.

65. When is an oil trap installed?

    a. when the evaporator is ten feet or more below the compressor.
    b. when the evaporator is ten feet or more above the compressor.
    c. when the evaporator is six feet or more below the compressor.
    d. when the evaporator is twelve feet above the compressor.

Student: ____________________ File Code: 751.02.02.00

Date: ____________________ Date Published: 1-27-78

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

UNIT PERFORMANCE TEST: BASIC HEATING AND AIR CONDITIONING

OBJECTIVE 1:

Draw a pictorial wiring diagram of a central air conditioning unit. Draw a schematic diagram of a central air conditioning unit.

OBJECTIVE 2:

On an air conditioning unit or trainer, using appropriate tools, test equipment and procedures, troubleshoot the electrical portion of the unit and list what must be done to repair the unit.

TASK:

Using appropriate test equipment and troubleshooting procedures, identify four different electrical malfunctions from a possible twenty-four problems. Draw a pictorial wiring diagram and a schematic diagram of a central air doncitioning unit.

ASSIGNMENT:

CONDITIONS:

The student will be allowed to use any tools, equipment, and reference materials commonly found in a typical refrigeration repair shop. He will not receive any assistance from the instructor or other students. Also, he must troubleshoot and identify the four problems in four hours.

RESOURCES:

Printed Material:
  Manufacturer's specifications

Tools:
- Electronic analyzer
- Amprobe
- Adjustable wrench
- Socket wrench set
- Long nose pliers
- Diagonal cutters
- Screwdriver set
- Phillips set
- Utica Electrician's knife, standard size
- VOM
- Assortment of wire, fasteners, and repair parts
- Watt meter

Student: ____________________ **File Code:** 751.02.02.00

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Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

Family Pay Number: __________ Sex: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory_____ Unsatisfactory_____

	CRITERION	
	Met	Not Met
Objective 1:		
1. The pictorial drawing of the system is correct.		
Criterion: If the system were wired according to the		
diagram, it would function according to the		
manufacturer's specifications.		
2. The schematic wiring diagram is correctly drawn.		
Criterion: It compares to the manufacturer's		
schematic diagram.		
Objective 2:		
3. Uses test equipment properly.		
Criterion: Procedures used are those described in the		
manufacturer's specifications and directions.		
4. Recorded data is accurate. (volts, amps, ohms,		
watts).		
Criterion: To ± 5% of the manufacturer's specifications.		

(Checklist continued)

	CRITERION	
	Met	Not Met
5. Uses appropriate troubleshooting procedures.		
Criterion: Problem(s) are identified.		
6. List appropriate repair procedures.		
Criterion: The system, when repaired, would function		
according to the manufacturer's specifications.		
7. Follows safe practices and procedures.		
Criterion: No injury results to anyone and procedures		
used are approved by OSHA.		
8. The job is completed in a reasonable time.		
Criterion: Not to exceed 4 hours.		
The student must successfully complete 7 out of 8 line items		
to achieve an overall score of satisfactory.		

LAP TEST ANSWER KEY: ELECTRICITY

1. D
2. C
3. A
4. C
5. C
6. A
7. B
8. C
9. A
10. C

LAP TEST ANSWER KEY: THERMOSTATS

1. A
2. C
3. C
4. D
5. A
6. B
7. D
8. B
9. D
10. D

LAP TEST ANSWER KEY: HEATING FUNDAMENTALS

1. B
2. D
3. A
4. D
5. C
6. D
7. B
8. A
9. B
10. A

LAP TEST ANSWER KEY: HEATING COMPONENTS

1. C
2. A
3. D
4. C
5. A
6. B
7. A
8. C
9. B
10. A

LAP TEST ANSWER KEY: GAS HEATING

1. c
2. c
3. b
4. a
5. d

LAP TEST ANSWER KEY: OIL HEATING

1. C
2. A
3. A
4. C
5. A
6. B
7. D
8. A
9. C
10. B

LAP TEST ANSWER KEY: ELECTRIC HEATING

1. A
2. B
3. B
4. B
5. D
6. B
7. A
8. B
9. A
10. A

LAP TEST ANSWER KEY: COOLING FUNDAMENTALS

1. B
2. A
3. B
4. A
5. B
6. B
7. D
8. A
9. A
10. A
11. B
12. C
13. C

LAP TEST ANSWER KEY: COOLING COMPONENTS

1. C
2. A
3. A
4. B
5. B
6. A
7. A
8. C
9. B
10. B

LAP TEST ANSWER KEY: COOLING INSTALLATIONS

1. C
2. A
3. D
4. B
5. A
6. A
7. B
8. B
9. D
10. B

UNIT TEST ANSWER KEY: BASIC HEATING AND AIR CONDITIONING

LAP 01

1. D
2. C
3. A
4. C
5. C
6. A
7. B
8. C
9. A
10. C

LAP 02

11. A
12. C
13. C
14. D
15. A

LAP 03

16. B
17. D
18. A
19. D
20. C
21. D
22. B
23. A
24. B
25. A

LAP 04

26. C
27. D
28. A
29. B
30. B

LAP 05

31. C
32. C
33. B
34. A
35. D

LAP 06

36. C
37. A
38. A
39. D
40. A

LAP 07

41. B
42. B
43. B
44. [illegible] C
45. A

LAP 08

46. B
47. A
48. B
49. A
50. B
51. B
52. D
53. A
54. A
55. A

LAP 09

56. A
57. A
58. A
59. C
60. B

LAP 10

61. C
62. A
63. D
64. [illegible] A
65. A

File Code: 751.02.03.01

Date Published: 11/4/77

Family Education Program

Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: SILVER SOLDERING

INTRODUCTION:

This LAP covers the use of silver soldering on refrigeration sealed system. The only prerequisite is to have read and completed successfully the previous units.

REVIEW:

Most joints in refrigeration units are silver soldered. This type of joint can withstand constant vibration and high pressure without cracking. A technician must know how to silver solder to do a sealed system repair.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Use a torch and tips in a safe and appropriate manner.
2. Prepare work properly.
3. Silver solder a joint.

ASSIGNMENT:

Study Chapter 2 in Modern Refrigeration and Air Conditioning, covering silver solder or brazing.

WRITTEN EVALUATION:

When you complete the assignment, take the written test. Upon successful completion, continue.

DEMONSTRATION:

Have your instructor demonstrate how to silver solder a joint.

PERFORMANCE:

Get the following tools out: torch, twin tip, twister tip, silver solder, flux, abrasive for cleaning tubing, striker, flaring block, swagging tools, hammer, pipe cutter and reamer, and rag. Go to the work station and cut five (5) lengths of tubing, 6" long, various size diameter. Swag the ends, clean flux and silver solder these joints. Have your instructor check all work. When you are done, clean-up your mess and put your tools away.

Principal Author(s): John Carey

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your performance work. All items must be accomplished successfully as assessed by your instructor.

SUMMARY:

Have your instructor go over your test with you. You should now understand the following:

1. What materials and tools are needed to silver solder.
2. How to silver solder.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ____________________ File Code: 751.02.03.01

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST: SILVER SOLDERING

1. Why is it important to clean metal before flexing and silver soldering?

   a. the silver solder won't dull.
   b. so the flux can be applied easier.
   c. so you have a good leak proof joint.
   d. clean metal heats faster.

2. When soldering how hot must the metal be?

   a. 600 degrees.
   b. 900 degrees.
   c. 1800 degrees.
   d. 1200 degrees.

3. How do you cut a cap tube?

   a. with a hammer and chisel.
   b. with a wire cutter.
   c. with a tubing cutter.
   d. with a file.

4. How can you tell when the correct silver brazing temperature is raised?

   a. the flux becomes clear and transparent.
   b. the flux becomes brown and dull colored.
   c. the fitting becomes blue.
   d. the flux begins to bubble.

5. What amount of silver solder is used to make a tight joint?

   a. ¼ ounce.
   b. 2 inches.
   c. approximately the length, approximately the diameter of the joint being soldered.
   d. three (3) times the diameter of the joint.

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Family Education Program

Learning Activity Package

Student: __________

Date: __________

PERFORMANCE ACTIVITY: EVACUATING, CHARGING AND LEAK TESTING

INTRODUCTION:

This LAP covers evacuating, charging and leak testing a sealed system. The only prerequisite is to have read and completed successfully the previous LAP.

REVIEW:

Everytime a sealed system is opened for a major repair, it should be evacuated, charged and leak tested. A technician must be able to do this if he is going to make a sealed system repair.

COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Set up a manifold set, vacuum pump charging cylinder and micron gauge on a sealed system.
2. Charge a system using a charging cylinder and a sight glass.
3. Check for leaks using bubble solution, halide torch detector, electronic leak detector and liquid tracer.

ASSIGNMENT:

Study Chapters 12 & 15 in Modern Refrigeration and Air Conditioning, covering evacuation, charging and leak detecting, installing gauges, service valve process tubes, charging cylinder, micron gauge driers and filters. Go over experiment 5 in your lab manual covering charging the system.

WRITTEN EVALUATION:

When you complete the assignment, take the written test. Upon successful completion, continue.

DEMONSTRATION:

Have your instructor go over the use of the vacuum pump, leak detectors and micron gauge.

Principal Author(s): John Carey

Family Training Center, Inc.

PEFORMANCE:

Do experiment 5 in your lab manual covering charging the system. Be careful when working with the trainer, if you have any questions, ask your instructor before proceeding.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor check your experiment. All items must be accomplished successfully as assessed by your instructor.

SUMMARY:

Have your instructor go over your test. You should now understand the following:

1. The procedure for evacuating a system
2. Why you evacuate a system
3. How to charge a system accurately.
4. How to check a system for leaks.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ File Code: 751.02.03.02

Date: ______________________ Date Published: 11-18-77

Family Education Program

LAP TEST: EVACUATING, CHARGING AND LEAK TESTING

1. What do you use to discharge refrigerant gas to the outside air?

    a. A coil hose.
    b. A purging hose.
    c. An evacuating hose.
    d. A restriction hose.

2. When evacuating a system what should you look for?

    a. An acid content.
    b. Moisture content.
    c. Proper oil content.
    d. Correct dryer size.

3. What must you place on most domestic refrigerators before you can evacuate a system?

    a. Pressure release valve.
    b. Over load valve.
    c. Process valve.
    d. Tap-a-can valve.

4. What is the best method for checking for leaks?

    a. Bubble solution.
    b. Alid torch.
    c. Electronic leak detector.
    d. Pulling a vacuum.

5. What do you use for measuring a charge in a system?

    a. An offset scale.
    b. Charging cylinder.
    c. Micron gauge.
    d. Measuring cup.

6. When changing a burnt out compressor before charging and installing a dryer what should be done to the system?

    a. Flush it out with a warm soapy solution.
    b. Flush it out with some diesel fuel.
    c. Flush it out with some refrigerant.
    d. Flush it out with calcium chloride.

7. When checking for leaks what type of working conditions should you have?

   a. Well lighted area.
   b. Clean place to work.
   c. Well ventilated area.
   d. Easy access to components.

8. When charging a system if you can not get the full charge to go into the system, what do you do?

   a. Don't worry about it.
   b. Put it in on the high side.
   c. Heat the charging cylinder up.
   d. Apply 30 pounds of air pressure.

9. When a refrigerant cylinder is inverted what will come out?

   a. Vapor.
   b. Liquid.
   c. Nothing.
   d. A combination of vapor-liquid.

10. What do you use to evacuate a system?

   a. Low pressure pump.
   b. High vacuum pump.
   c. A filter dryer.
   d. An air compressor.

File Code: 751.02.03.03

Date Published: 11/4/77

Family Education Program

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: MISCELLANEOUS SYSTEM REPAIR

INTRODUCTION:

This LAP covers miscellaneous sealed system repairs that you may have to perform on refrigeration systems. The only prerequisite is to have read and completed successfully the previous LAPS.

REVIEW:

There are many sealed system repairs done which must be covered. There are several methods of doing them, all are correct if they follow manufacturer's specifications. A service technician must practice good sealed system repair procedures.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Replace the following:
    a. Drier filter
    b. Sight glass
    c. Condenser
    d. Evaporator
    e. Heat exchanger
    f. Accumulator
    g. Liquid receiver
2. Repair leaks in refrigeration lines by using epoxy and silver solder.
3. Add oil to a system.
4. Flush a system.

ASSIGNMENT:

Study Chapters 12 & 15 in Modern Refrigeration and Air Conditioning, covering the miscellaneous system repairs, evaporator, condenser, drier, service valves, etc.

WRITTEN EVALUATION:

When you have completed the assignment, take the written test. Upon successful completion, continue.

Principal Author(s): John Carey

DEMONSTRATION:

Ask the instructor to help if you have a problem.

PERFORMANCE:

Have your instructor assign a refrigerator for you to work on. Silver solder on some service valves. Check the systems for proper operation and leaks. Notify the instuctor when you have completed.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your Performance Test. All items must be accomplished successfully before proceeding.

SUMMARY:

Have your instructor go over your test. You should now understand the following:

1. How to perform a sealed system repair according to manufacturer's specifications.
2. Why a dry system is important.

After successfuly completion, record LAP on SPR and proceed to the next LAP.

Student: ____________________ File Code: 751.02.03.03

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST: MISCELLANEOUS SYSTEM REPAIRS

1. When replacing a dryer, what should be done so you don't ruin it?

   a. wrap a cold wet rag around it.
   b. make sure it is in a vertical position.
   c. make sure it is in a horizontal position.
   d. epoxy it on.

2. When replacing a dryer, does it matter in what direction the dryer is installed?

   a. no.

   b. yes, it has to be in a vertical position.
   c. it has to be in a horizontal position.
   d. it should be installed with the arrow pointing in the direction of flow.

3. When replacing a condenser on a domestic system, would you:

   a. epoxy it on.
   b. flare it on.
   c. silver solder it on.
   d. weld it on.

4. When installing a suction line filter, why do they have process valves on each side of the filter?

   a. to take temperature drops across the filter.
   b. to take pressure drops across the filter.
   c. to evacuate the filter.
   d. to charge the filter.

5. What is the purpose of the oil separator?

   a. return oil to compressor.
   b. separate moisture from the oil.
   c. clean the oil.
   d. keep proper amount of oil in the system.

Family Education Program

File Code: 751.02.03.04

Date Published: 11/4/77

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: COMPRESSOR CHANGE

INTRODUCTION:

This LAP covers changing a compressor in a sealed system. The only prerequisite is to have read and completed successfully the previous LAP.

REVIEW:

Compressor changes are the most common sealed system repairs done on a refrigeration system. A technician must know how to change one correctly.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Remove compressor from a typical system.
2. Install a compressor, making sure all lines are hooked up correctly.

ASSIGNMENT:

Study Chapters 12 & 15 in Modern Refrigeration and Air Conditioning, covering compressors and replacement procedures.

WRITTEN EVALUATION:

When you complete the assignment, take the written test. Upon successful completion, continue.

DEMONSTRATION:

None - Ask for assistance if you have problems.

PERFORMANCE:

Have your instructor assign you a unit to work on. Install service valves, discharge unit, remove compressor, flush lines, replace the compressor, pump down, recharge and check for leaks.

Principal Author(s): John Carey

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your Performance Test. All items must be accomplished successfully as assessed by your instructor.

SUMMARY:

Have your instructor go over your test. You should now understand:

1. The procedure for changing a compressor.
2. Why a clean, neat, tight system is needed.

After successful completion, record LAP on SPR. Study for your Unit written and Performance Test. Tell your instructor when you are ready to take the tests. After successful completion, have your instructor sign off the unit, then proceed to the next unit.

Student: ____________________ File Code: 751.02.03.04

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST: COMPRESSOR CHANGE

1. Before installing a new compressor, what should be checked?

   a. oil level of new compressor.
   b. color of compressor.
   c. BTU rating of compressor.
   d. high pressure kick-out switch.

2. Which stub coming off the compressor is usually the largest?

   a. oil cooler line.
   b. first discharge line.
   c. second discharge line.
   d. suction line.

3. After installing a compressor, what should you do with the line?

   a. coil the suction line.
   b. coil the capillary tube.
   c. make sure none of the lines are rubbing.
   d. paint all lines orange.

4. What must be done when a compressor is changed?

   a. condenser removed.
   b. accumulator added.
   c. replace dryer.
   d. put on new support mounts.

5. What do you never do to compressor stub?

   a. cut them with a tubing cutter.
   b. clean them off.
   c. swag them.
   d. bend them.

Student: ____________________ **File Code:** 751.02.03.00

Date: ____________________ **Date Published:** 2-17-78

Family Education Program

UNIT TEST: SEALED SYSTEM REPAIRS

75.02.03.01

1. Why is it important to clean metal before flexing and silver soldering?

   a. the silver solder won't dull.
   b. so the flux can be applied easier.
   c. so you have a good leak proof joint.
   d. clean metal heats faster.

2. When soldering, how hot must the metal be?

   a. 600 degrees.
   b. 900 degrees.
   c. 1800 degrees.
   d. 1200 degrees.

3. How do you cut a cap tube?

   a. with a hammer and chisel.
   b. with a wire cutter.
   c. with a tubing cutter.
   d. with a file.

4. How can you tell when the correct silver brazing temperature is raised?

   a. the flux becomes clean and transparent.
   b. the flux becomes brown and dull colored.
   c. the flux becomes blue.
   d. the flux begins to bubble.

5. What amount of silver solder is used to make a tight joint?

   a. 1/4 ounce.
   b. 2"
   c. approximately the length, approximately the diameter of the joint being soldered.
   d. three (3) times the diameter of the joint.

75.02.03.02

6. What do you use to discharge refirgerant gas to the outside air?

   a. a coil hose.
   b. a purging hose.
   c. an evacuating hose.
   d. a restriction hose.

75.02.03.02 (continued)

7. What must you place on most domestic refrigerators before you can evacuate a system?

   a. pressure release valve.
   b. over load valve.
   c. process valve.
   d. Tap-a-can valve.

8. What is the best method for checking for leaks?

   a. bubble solution.
   b. a lid torch.
   c. electronic leak detector.
   d. pulling a vacuum.

9. When changing a burnt out compressor before charging and installing a dryer, what should be done to the system?

   a. flush it out with a warm soapy solution.
   b. flush it out with some diesel fuel.
   c. flush it out with some refrigerant.
   d. flush it out with calcium chloride.

10. What do you use to evacuate a system?

   a. low pressure pump.
   b. high vacuum pump.
   c. a filter dryer.
   d. an air compressor.

75.02.03.03

11. Before installing a new compressor, what should be checked?

   a. oil level of new compressor.
   b. color of compressor.
   c. BTU rating of compressor.
   d. high pressure kick-out switch.

12. Which stub coming off the compressor is usually the largest?

   a. oil cooler line.
   b. first discharge line.
   c. second discharge line.
   d. suction line.

13. After installing a compressor, what should you do with the line?

   a. coil the suction line.
   b. coil the capillary tube.
   c. make sure none of the lines are rubbing.
   d. paint all lines orange.

75.02.03.03 (continued)

14. What must be done when a compressor is changed?

    a. condenser removed.
    b. accumulator added.
    c. replace dryer.
    d. put on new support mounts.

15. What do you never do to compressor stub?

    a. cut them with a tubing cutter.
    b. clean them off.
    c. swag them.
    d. bend them.

75.02.03.04

16. When replacing a dryer, what should be done so you don't ruin it?

    a. wrap a cold wet rag around it.
    b. make sure it is in a vertical position.
    c. make sure it is in a horizontal position.
    d. epoxy it on.

17. When replacing a dryer, does it matter in what direction the dryer is installed?

    a. no.
    b. yes, it has to be in a vertical position.
    c. it has to be in a horizontal position.
    d. it should be installed with the arrow pointing in the direction of flow.

18. When replacing a condenser on a domestic system, would you:

    a. epoxy it on.
    b. flare it on.
    c. silver solder it on.
    d. weld it on.

19. When installing a suction line filter, why do they have process valves on each side of the filter?

    a. to take temperature drops across the filter.
    b. to take pressure drops across the filter.
    c. to evacuate the filter.
    d. to charge the filter.

20. What is the purpose of the oil separator?

    a. return oil to compressor.
    b. separate moisture from the oil.
    c. clean the oil.
    d. keep proper amount of oil in the system.

Student: ______________________ File Code: 751.02.03.00

Date: ______________________ Date Published: 1-27-78

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

UNIT PERFORMANCE TEST: SEALED SYSTEMS REPAIR

OBJECTIVE 1:

Using appropriate tools, equipment, supplies, and procedures, locate and correct troubles in a typical refrigerator or window air conditioner.

TASK:

Repair and service a domestic refrigerator or a window air conditioner, using appropriate tools, equipment, supplies, and procedures.

ASSIGNMENT:

CONDITIONS:

You will be allowed to use all the typical tools, equipment, supplies, and references commonly found in a typical refrigeration repair shop. You will not be allowed to receive any assistance from the instructor or other students.

RESOURCES:

Printed Material:

Modern Refrigeration and Air Conditioning, Althouse

Equipment:

A charged, but inoperative hermetic refrigerator.
One window air conditioner.

RESOURCES (Cont.):

Tools:

1 Hermetic service valve attachment kit
1 8 inch adj. open wrench
1 4 inch screwdriver - 1/4" x 1/32" blade
1 1/4" ratchet wrench
1 Set open end wrenches
1 6" screwdriver - 1/4" blade
1 #2 Phillips screwdriver
1 Pair safety goggles
1 Oiler with SAE 30

Instruments:

1 Hermetic analyzer or test light
1 Thermometer
1 Gauge manifold with refrigerant lines
1 Vacuum pump
1 Electrical analyzer

Supplies:

1 12" length of 1/8" dia. 50-50 solder
1 Clamp-on service valve
1 Can soldering flux
1 Wiping cloth

ASSIGNMENT SHEET

OBJECTIVE 1: HERMETIC SYSTEM

1. Start the system. If the unit won't start:
   - (a) Check the electrical circuit, wall receptacles, thermostat, relay, capacitor, and wiring.
   - (b) If internal trouble is indicated, a shop overhaul or replacement is necessary.

2. If the unit starts but shuts off almost immediately, this trouble indicates an overload. The motor overload device is opening the circuit. Locate the trouble, repair if external or a major overhaul is necessary.

3. If the unit runs continuously with little or no refrigeration,
   - (a) Check for a dirty condenser or poor air flow
   - (b) Install gauge manifold to determine the low and high side operating pressures and to check for refrigerant charge, clogged screens, etc.

4. If the unit refrigerates, but not satisfactorily, check for moisture in system or lack of refrigerant.

5. If the unit over-refrigerates (too cold), check the motor control thermostat.

Name of Unit________________________ Model____________________ Year_______________

Kind of Refrigerant__________________ Amount of Refrig., Lbs.________ Oz.___________

Normal Head Pressure____________________ Normal Low Side Pressure_________________

Remarks:

ASSIGNMENT SHEET

OBJECTIVE 1: WINDOW TYPE COMFORT COOLER

1. Test the external circuit first: Power in, thermostat, relay, capacitors, overload protectors, motor compressor, filters, air flow, etc.
2. Install gauges and test for leaks.
3. Run the unit for at least fifteen minutes.
4. If the unit is frosting or sweating down the suction line, the system may be overcharged.
5. If the coil is starved, the screen or drier is partially clogged with moisture or dirt or the unit is undercharged.
6. Repair what is necessary. Remove the refrigerant. BE CAREFUL! Replace the worn part. Assemble the unit. Evacuate the air, charge, and test for leaks.

	At the Beginning	After 15 Minutes	After Repair
Low Side Pressure			
High Side Pressure			
Suction Line Temp., Approx.			
Liquid Line Temp., Approx.			
Evaporator Air Temperature			
Noise: Compressor			
Motor			

Remarks:

Student: ______________________ File Code: 751.02.03.00

Date: ______________________ Date Published: ______________________

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

Family Pay Number: ____________ Sex: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory_____ Unsatisfactory_____

	CRITERION	
	Met	Not Met
Objective 1:		
1. Uses appropriate safety procedures.		
Criterion: No injury results to anyone and procedures used compare to OSHA requirements.		
2. Uses appropriate tools and equipment, and supplies.		
Criterion: Modern Refrigeration and Air Conditioning, paragraphs 8-36, 12-1 through 12-23, 3-22, 9-19 through 9-22, 15-99, 21-5, 21-7, and manufacturer's specifications and directions.		
3. Uses appropriate troubleshooting procedures.		
Criterion: Locates the malfunction without assistance from other people.		
4. Uses appropriate repair procedures.		
Criterion: Modern Refrigeration and Air Conditioning, and Manufacturer's specifications and directions.		
5. Work is neat and professional.		

(Checklist continued)

	CRITERION	
	Met	Not Met
Criterion: Modern Refrigeration and Air Conditioning, and		
Manufacturer's specifications and directions.		
6. Gauge manifold is properly installed.		
Criterion: Modern Refrigeration and Air Conditioning, 12-17.		
7. Data requested on the job sheet is accurate and complete.		
Criterion: Compares to manufacturer's specifications.		
8. System has no leaks		
Criterion: No leaks can be detected by the instructor.		
9. All electrical and mechanical connections and		
fastenings are appropriate.		
Criterion: Mechanical installations compare to the manufacturer's specifications		
and electrical connections are correct according to the NEC		
(National Electrical Code.)		
10. System is operational.		
Criterion: It functions according to the manufacturer's specifications		
11. The job is completed in a reasonable time.		
Criterion: Not to exceed 6 hours.		
The student cannot miss line items 10 or 11. Otherwise, he		
must satisfactorily complete 7 out of 9 items to pass this test.		

LAP TEST ANSWER KEY: SILVER SOLDERING

1. C
2. D
3. D
4. A
5. C

LAP TEST ANSWER KEY: EVACUATE, CHARGE, AND LEAK TEST

1. B
2. A
3. C
4. C
5. B
6. C
7. C
8. C
9. B
10. B

LAP TEST ANSWER KEY: MISCELLANEOUS SYSTEM REPAIRS

1. A
2. D
3. C
4. C
5. C

LAP TEST ANSWER KEY: COMPRESSOR CHARGE

1. A
2. D
3. C
4. B
5. A

UNIT TEST ANSWER KEY: SEALED SYSTEM REPAIRS

LAP 01

1. C
2. D
3. D
4. A
5. C

LAP 02

6. B
7. C
8. C
9. C
10. B

LAP 03

11. A
12. D
13. C
14. C
15. C

LAP 04

16. A
17. D
18. C
19. B
20. A

File Code: 751.02.04.01

Date Published: 11/4/77

Family Education Program

Learning Activity Package

Student:

Date:

PERFORMANCE ACTIVITY: ICE

INTRODUCTION:

This LAP covers the ice type of refrigeration system. The only prerequisite is to have completed the previous 2 units satisfactorily.

REVIEW:

The ice system is one of the oldest types of refrigeration systems. It clearly demonstrates the process of heat movement in a typical refrigeration system. This should help you understand how a refrigeration system works.

COMPETENCY:

Upon successful completion of this LAP, you should be able to do the following:

1. Be able to explain the principle of refrigeration.
2. Be able to explain how ice can be used for refrigeration.

ASSIGNMENT:

Study Chapter 3 in Modern Refrigeration and Air Conditioning, covering the ice system of refrigeration.

WRITTEN EVALUATION:

When you complete the assignment, take the written test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

None.

Principal Author(s): John Carey

Family Training Center, Inc.

PERFORMANCE EVALUATION:

There is no performance evaluation.

SUMMARY:

Go over the test with your instructor, you should now understand the following:

1. How heat is transferred in an ice system.

After successful completion of this LAP, record it on your SPR and proceed to the next LAP.

- a. Between 35 and 45 degrees.
- b. Between 40 and 50 degrees.
- c. Between 50 and 60 degrees.
- d. Between 25 and 30 degrees Fahrenheit.

8. At what temperature does ice freeze?

   - a. 33 degrees Fahrenheit.
   - b. 31 degrees Fahrenheit.
   - c. 32 degrees Fahrenheit.
   - d. 29 degrees Fahrenheit.

9. When using ice for cooling temperatures below 32 degrees, what is needed?

   - a. A salt mixture.
   - b. An acid mixture.
   - c. Sand mixed with the water.
   - d. Colder temperature to freeze ice at.

Family Education Program

File Code: 751.02.04.02

Date Published: 11/4/77

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: WATER EVAPORATION

INTRODUCTION:

This LAP covers the water evaporation type of refrigeration system. The only prerequisite is to have read and understood the pevious LAP.

REVIEW:

An understanding of the water evaporation system will help in understanding heat transfer and movement in a refrigeration system.

COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Explain how water evaporation refrigeration functions.
2. Be able to answer the test questions correctly.

ASSIGNMENT:

Study Chapter 3 in Modern Refrigeration and Air Conditioning, (Althouse, Turnquist, Bracciano), covering water evaporative refrigeration.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

None.

Principal Author(s): John Carey

PERFORMANCE EVALUATION:

Go over the test with your instructor. You should now understand the following:

1. How a water evaporation cycle operates.
2. How heat transfer is produced.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ File Code: 751.02.04.02

Date: ______________________ Date Published: 11-18-77

Family Education Program

LAP TEST: WATER EVAPORATIVE REFRIGERATION

1. What happens when a fluid evaporates?

   a. Heat is absorbed.
   b. Heat is lost.
   c. Cold is absorbed.
   d. Cold is lost.

2. What happens when moisture is evaporated from a person's skin?

   a. It becomes warmer.
   b. It becomes cooler.
   c. Nothing.
   d. Breaks out in a rash.

3. What keeps a desert water bag cool?

   a. Rapid evaporation.
   b. It gets cold on the desert at night.
   c. The water keeps it cold.
   d. The bag gets just as warm as anything else in the desert.

4. If the desert bag was water proof, would the water become cool?

   a. Yes.
   b. No.
   c. Only if it was completely full.
   d. Only when there is a lot of humidity in the air.

5. Why is it not a good idea for the desert water bag to become warm?

   a. Because warm water will make you sick.
   b. Because the water will evaporate.
   c. Because warm water creates a calcium residue on the liner of the bag.
   d. Desert water bags do not become warm if filled with water.

File Code: 751.02.04.03

Date Published: 11/4/77

Family Education Program

Learning Activity Package

Student: ________________

Date: ________________

PERFORMANCE ACTIVITY: COMPRESSION

INTRODUCTION:

This LAP covers the typical compression system cycle in a refrigeration unit. The only prerequisite is to have read and completed successfully the previous LAP.

REVIEW:

The compression type unit is the most commonly used refrigeration system today. There are several types of compression systems. A service technician must know the difference between them and how they all operate.

COMPETENCY:

Upon successful completion of this LAP you will be able to explain the operation of the following compression systems cycles:

1. Capillary tube.
2. Thermostatic expansion valve.
3. Automatic expansion valve.

ASSIGNMENT:

1. Study Chapter 3 in Modern Refrigeration and Air Conditioning, covering compression systems.
2. Be able to answer test questions correctly.

WRITTEN EVALUATION:

When you feel you have mastered the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

Have the instructor go over the refrigeration trainer with you.

Principal Author(s): John Carey

Family Training Center, Inc.

PERFORMANCE:

Do experiments 5,6,7,8 in your experiment book, Lab Manual for Refrigeration and Air Conditioning. Answer all questions in lab book.

PERFORMANCE EVALUATION:

Notify the instructor when you are ready to take the Performance Test. Have the instructor go over your Performance Test with you. All items should be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. The types of compression systems most commonly used.
2. What the different cycles are for these types of systems.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ File Code: 751.02.04.03

Date: ______________________ Date Published: 12-13-77

Family Education Program

LAP TEST: COMPRESSION

1. Name three (3) common metering devices.

   a. AXV, TXV, high side switch
   b. AXV, TXV, cap tube
   c. TXV, low side switch
   d. Cap tube, TXV, low side valve

2. What are the four(4) main parts in a compression system?

   a. Compressor, condenser, evaporator, metering device
   b. High side switch, evaporator, cindenser, compressor
   c. Compressor, evaporator, condenser, low side switch
   d. AXV, TXV, cap tube, compressor

3. In a compression system, what does the compressor do?

   a. Compresses a liquid
   b. Compresses a gas
   c. Compresses a solid
   d. Compresses high pressure liquid

4. Where is the metering device located in a compression system?

   a. Between the compressor and ecaporator
   b. Between the evaporator and condenser
   c. Between the condenser and compressor
   d. Between heat exchanger and thermal element

5. Where is the low pressure area in a compression system?

   a. Condenser
   b. Evaporator
   c. Compressor
   d. Condenser

File Code: 751.02.04.04

Date Published: 11/4/77

Family Education Program

Learning Activity Package

Student:

Date:

PERFORMANCE ACTIVITY: ABSORPTION

INTRODUCTION:

This LAP covers the Absorption System of Refrigeration. The only prerequisite is to have read and completed successfully the previous LAP.

REVIEW:

This LAP explains how a Refrigeration System operates without a compressor using heat to transfer the refrigerant. This type of system is used on camper units and other small portable refrigerators. It is used alot on older domestic units and central air.

COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Explain the operation of an absorption cycle.
2. Be able to answer test questions correctly.

ASSIGNMENT:

Study Chapter 3 in Modern Refrigeration and Air Conditioning, covering absorption systems.

WRITTEN EVALUATION:

Upon completion of the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

None.

Principal Author(s): John Carey

Family Training Center, Inc.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. Understand the operation of an absorption system.
2. Understand how it is used in refrigeration.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ____________________ **File Code:** 751.02.04.04

Date: ____________________ **Date Published:** 11-18-77

Family Education Program

LAP TEST: ABSORPTION SYSTEMS

1. What type of refrigerant is used in the generator of an absorption system?

    a. Freon 12
    b. Freon 22
    c. Carbon
    d. Amonia water

2. What is done to the fluid in the generator?

    a. It is heated.
    b. It is cooled.
    c. It is mixed thoroughly.
    d. It is inverted.

3. What happens to the amonia gas in the condenser?

    a. It turns to a vapor.
    b. It is cooled and condensed to a liquid.
    c. It is heated and condensed to a liquid.
    d. It is heated and condensed to a vapor.

4. After being condensed, where does the liquid amonia flow?

    a. Into accumulator.
    b. Into a filter dryer.
    c. Into the receiver.
    d. Into the distribution tubes.

5. What is the most popular fuel used in an intermittent absorption system?

    a. Gasoline.
    b. Diesel
    c. LP
    d. Kerosene

6. What does a continuous cycle absorption system use to generate heat?

    a. Gas and electricity.
    b. Electricity and water vapor.
    c. Gas
    d. Heat from the engine.

7. In a continuous cycle absorption system, what is usually contained in the generator?

   a. Amonia and water.
   b. Carbon and water.
   c. Refrigerant II.
   d. Refrigerant 22.

8. What is the approximate pressure of a continuous cycle absorption system?

   a. 200 lb. per square inch.
   b. 176 lb. per square inch.
   c. 380 lb. per square inch.
   d. 125 lb. per square inch.

9. How many moving parts are there in the refrigerating mechanism of a continuous cycle absorption system?

   a. 3
   b. 2
   c. 1
   d. None.

10. What kind of experiments were performed by Michael Faraday?

    a. To liquify gases.
    b. That Freon is heavier than air.
    c. That amonia could be heated.
    d. That amonia was a poor refrigerant.

11. What is an important part of installation in a continuous cycle absorption system?

    a. It has to be leveled carefully.
    b. It has to be free of vibrations.
    c. It cannot be in contact with any walls.
    d. It has to be on a 5 degree angle.

Family Education Program

File Code: 751.02.04.05

Date Published: 11/4/77

Learning Activity Package

Student: ____________

Date: ____________

PERFORMANCE ACTIVITY: AUTO AIR CONDITIONING

INTRODUCTION:

This LAP covers the typical automotive air conditioning system cycle. The only prerequisite is to have read and completed successfully the previous LAP.

REVIEW:

There are several million car air conditioners out. They all have about the same refrigeration cycle. A good understanding of the system is needed to be competent in servicing these units.

COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Explain a typical auto air conditioning refrigerant cycle.
2. Be able to answer test questions correctly.

ASSIGNMENT:

Study Chapter 3 in Modern Refrigeration and Air Conditioning, covering auto air conditioning.

WRITTEN EVALUATION:

After completion of the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

None.

Principal Author(s): John Carey

Family Training Center, Inc.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the written test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. The cycle of a typical auto air conditioner.
2. How heat movement or transfer takes place.

After successful completion, record LAP on SPR. Study for the Unit Written and Performance Tests. Notify your instructor when you feel you are ready to take the tests.

Student: ____________________ File Code: 751.02.04.05

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST: AUTOMOBILE AIR CONDITIONING

1. Where is the condenser on an automotible located?
    a. behind the car radiator.
    b. in front of the car radiator.
    c. underneath the right front fender.
    d. behind the compressor.

2. How is the compressor driven?
    a. by electric motor.
    b. off the drive shaft.
    c. off the front of the car engine.
    d. by a separate gas engine.

3. What controls the magnetic clutch on the compressor?
    a. a thermostat.
    b. a low pressure switch.
    c. a high pressure switch.
    d. a cooling anticipator located under the condenser fan.

4. What is used to control the flow of refrigerant in the system?
    a. a capillary tube.
    b. a suction throttling valve.
    c. an automatic expansion valve.
    d. a pressure release valve.

5. At what speed does the compressor run?
    a. 2800 rpm.
    b. 3600 rpm.
    c. 1800 rpm.
    d. it depends on how fast the car engine is running.

6. What is used to check to see how much refrigerant is in the system?
    a. a temperature gauge.
    b. a sight glass.
    c. a manometer.
    d. an analyzer.

7. Are all car air conditioners made by the same company?

   a. yes.
   b. no, they are made by several companies.
   c. they are made by Frigidaire and York.
   d. they are imported from Europe.

8. What type of compressors are used in the majority of car air conditioners?

   a. reciprocating.
   b. rotary.
   c. centrifugal.
   d. absorptions.

9. How does a load factor differ in a car air conditioner compared to a house air conditioner?

   a. there is no difference.
   b. it is just about the same.
   c. the load in a car air conditioner changes drastically.
   d. the load factor in a house changes drastically.

10. Where do you find the amount of charge a system will hold?

    a. it is stamped on the door frame of the car.
    b. you just charge them all according to the sight glass.
    c. you charge the system until it frosts back.
    d. there is usually a metal plate with the charge stamped on the compressor.

11. What is usually the main cause of loss of refrigerant in a car air conditioner?

    a. ruptured evaporator.
    b. ruptured condenser.
    c. leaky expansion valve.
    d. the main seal in the compressor has gone out.

Student: ______________________ File Code: 751.02.04.00

Date: ______________________ Date Published: 2-17-78

Family Education Program

UNIT TEST: BASIC REFRIGERATION SYSTEMS

75.02.04.01

1. Are ice refrigeration systems still used?

   a. no.
   b. only at the north pole.
   c. both at the north and south pole.
   d. yes, they are still used in various applications.

2. In an ice box, where is the ice located?

   a. at the bottom of the unit.
   b. at the top of the unit.
   c. in the middle of the unit.
   d. in the back of the unit.

3. An ice refrigerator has to have what qualities?

   a. large area.
   b. small area.
   c. be well insulated.
   d. water resistant.

4. What is one advantage of an ice refrigerator system?

   a. its high humidity.
   b. its low humidity.
   c. it's easily cared for.
   d. ice is easy to come by.

5. What is the average range of temperature in an ice refrigerator.

   a. between 35 and 45 degrees.
   b. between 40 and 50 degrees.
   c. between 50 and 60 degrees.
   d. between 25 and 30 degrees Fahrenheit.

75.02.04.02

6. What happens when a fluid evaporates?

   a. heat is absorbed.
   b. heat is lost.
   c. cold is absorbed.
   d. cold is lost.

75.02.04.02 (continued)

7. What happens when moisture is evaporated from a person's skin?

   a. it becomes warmer.
   b. it becomes cooler.
   c. nothing.
   d. breaks out in a rash.

8. What keeps a desert water bag cool?

   a. rapid evaporation.
   b. it gets cold on the desert at night.
   c. the water keeps it cold.
   d. the bag gets just as warm as anything else in the desert.

9. If the desert bag was water proof, would the water become cool?

   a. yes.
   b. no.
   c. only if it was completely full.
   d. only when there is a lot of humidity in the air.

10. Why is it not a good idea for the desert water bag to become warm?

   a. because warm water will make you sick.
   b. because the water will evaporate.
   c. because warm water creates a calcium residue on the liner of the bag.
   d. desert water bags do not become warm if filled with water.

75.02.04.03

11. Name three (3) common metering devices.

   a. AXV, TXV, high side switch.
   b. AXV, TXV, cap tube.
   c. TXV, low side switch.
   d. cap tube, TXV, low side valve.

12. What are the four (4) main parts in a compression system?

   a. compressor, condenser, evaporator, metering device.
   b. high side switch, evaporator, condenser, compressor.
   c. compressor, evaporator, condenser, low side switch.
   d. AXV, TXV, cap tube, compressor.

13. In a compression system, what does the compressor do?

   a. compresses a liquid.
   b. compresses a gas.
   c. compresses a solid.
   d. compresses high pressure liquid.

75.02.04.03 (continued)

14. Where is the metering device located in a compression system?

    a. between the compressor and evaporator.
    b. between the evaporator and condenser.
    c. between the condenser and compressor.
    d. between heat exchanger and thermal element.

15. Where is the low pressure area in a compression system?

    a. condenser.
    b. evaporator.
    c. compressor.
    d. liquid receiver.

75.02.04.04

16. What type of refrigerant is used in the generator of an absorption system?

    a. Freon 12.
    b. Freon 22.
    c. carbon.
    d. amonia water.

17. What happens to the amonia gas in the condenser?

    a. it turns to a vapor.
    b. it is cooled and condensed to a liquid.
    c. it is heated and condensed to a liquid.
    d. it is heated and condensed to a vapor.

18. After being condensed, where does the liquid amonia flow?

    a. into accumulator.
    b. into a filter dryer.
    c. into the receiver.
    d. into the distribution tubes.

19. What is the most popular fuel used in an intermittent absorption system?

    a. gasoline.
    b. diesel.
    c. LP
    d. kerosene.

20. What does a continuous cycle absorption system use to generate heat?

    a. gas and electricity.
    b. electricity and water vapor.
    c. gas.
    d. heat from the engine.

75.02.04.04 (continued)

21. In a continuous cycle absorption system, what is usually contained in the generator?

    a. amonia and water.
    b. carbon and water.
    c. refrigerant II.
    d. refrigerant 22.

22. What is the approximate pressure of a continuous cycle absorption system?

    a. 200 lbs. per square inch.
    b. 176 lbs. per square inch.
    c. 380 lbs. per square inch.
    d. 125 lbs. per square inch.

23. How many moving parts are there in the refrigerating mechanism of a continuous cycle absorption system?

    a. 3
    b. 2
    c. 1
    d. none.

24. What kind of experiments were performed by Michael Faraday?

    a. to liquify gases.
    b. that Freon is heavier than air.
    c. that amonia could be heated.
    d. that amonia was a poor refrigerant.

25. What is an important part of installation in a continuous cycle absorption system?

    a. it has to be leveled carefully.
    b. it has to be free of vibrations.
    c. it cannot be in contact with any walls.
    d. it has to be on a 5 degree angle.

75.02.04.05

26. Where is the condenser on an automobile located?

    a. behind the car radiator.
    b. in front of the car radiator.
    c. underneath the right front fender.
    d. behind the compressor.

27. How is the compressor driven?

    a. by electric motor.
    b. off the drive shaft.
    c. off the front of the car engine.
    d. by a separate gas engine.

75.02.04.05 (continued)

28. What controls the magnetic clutch on the compressor?

    a. a thermostat.
    b. a low pressure switch.
    c. a high pressure switch.
    d. a cooling anticipator located under the condenser fan.

29. What is used to control the flow of refrigerant in the system?

    a. a capillary tube.
    b. a suction throttling valve.
    c. an automatic expansion valve.
    d. a pressure release valve.

30. At what speed does the compressor run?

    a. 2800 rpm.
    b. 3600 rpm.
    c. 1800 rpm.
    d. it depends on how fast the car engine is running.

31. What is used to check to see how much refrigerant is in the system?

    a. a temperature gauge.
    b. a sight glass.
    c. a manometer.
    d. an analyzer.

32. Are all car air conditioners made by the same company?

    a. yes.
    b. no, they are made by several companies.
    c. they are made by Frigidaire and York.
    d. they are imported from Europe.

33. What type of compressors are used in the majority of car air conditioners?

    a. reciprocating.
    b. rotary.
    c. centrifugal.
    d. absorption.

34. How does a load factor differ in a car air conditioner compared to a house air conditioner?

    a. there is no difference.
    b. it is just about the same.
    c. the load in a car air conditioner changes drastically.
    d. the load factor in a house changes drastically.

75.02.04.05 (continued)

35. Where do you find the amount of charge a system will hold?

a. it is stamped on the door frame of the car.
b. you just charge them all according to the sight glass.
c. you charge the system until it frosts back.
d. there is usually a metal plate with the charge stamped on the compressor.

Student: ______________________ File Code: 751.02.04.00

Date: ______________________ Date Published: 1-27-78

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

UNIT PERFORMANCE TEST: BASIC REFRIGERATION SYSTEMS

OBJECTIVE 1:

Measure and record temperatures in Fahrenheit and Centigrade using appropriate tools, equipment, and procedures.

OBJECTIVE 2:

Calculate in BTU's the amount of energy needed to do a specified amount of work.

OBJECTIVE 3:

Identify the major components on a simple refrigeration system (evaporator, compressor, condenser).

TASK:

Using appropriate tools, equipment and supplies, take and record temperatures in Fahrenheit and Centigrade. Also, define the BTU and identify the major components of a simple refrigeration system (evaporator, condenser, and compressor).

ASSIGNMENT:

CONDITIONS:

You will be completing the tasks listed in conditions similar to those of a simple refrigeration repair shop. You will be allowed to use any resource commonly available to serviceman; i.e., reference texts, manufacturer's specifications and directions. The tasks must be completed in the time listed without any assistance from the instructor or other students.

RESOURCES:

Printed Material:
Modern Refrigeration and Air Conditioning, Althouse

Equipment:
Work station which provides a drain (sink), a hot plate, and a container for water or refrigerant.

Tools:
1 Wide-necked thermos bottle
1 Tablespoon
1 Quart aluminum open topped can
1 Small beaker
1 Pair safety goggles

Instruments:
1 Glass-stemmed thermometer calibrated in degrees F.
1 Glass-stemmed thermometer calibrated in degrees C.
1 Dial thermometer
1 Recording thermometer

Supplies:
1 Carton crushed ice
1 Package rock salt (fine)
1 Package paper toweling
1 1-lb cylinder R-12

ASSIGNMENT SHEET: OBJECTIVE 1

JOB SHEET

1. Fill the thermos bottle with crushed ice and water. Stir.
2. Insert the two thermometers. Note and record the temperature.
3. Pour out the water. Add 2 tablespoons full of rock salt. Add some water and stir for at least 3 minutes.
4. Insert the two thermometers. Note and record the temperature.
5. Fill the one quart aluminum can about 3/4 full with warm water and place it on the hot plate.
6. Install the two thermometers in the can. Heat to boiling. Record the temperatures.
7. Add two tablespoons full of rock salt to the boiling water; be careful, it may boil over.
8. Repeat Step 6 above, using only some liquid R-12, instead of ice and water.

DATA:

	Stem Thermometer				Dial Thermometer				Rec. Thermometer		
	°F.	°C.	R	K	°F.	°C.	R	K	°F.	R	K
Ice water mixture											
Ice salt mixture											
Boiling salt water											
R-12											

Remarks:

ASSIGNMENT SHEET: OBJECTIVE 2

BTU PROBLEM SHEET

How much heat will be required to raise the temperature of 62.4 lbs (1 cubic ft) of water from 40° F. to 80° F?

How much heat must be removed to cool 50 lbs of water from 80° F. to 35° F?

Student: ____________________ File Code: 751.02.04.00

Date: ____________________ Date Published: 11/14/74

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory_____ Unsatisfactory_____

	CRITERION	
	Met	Not Met
Objective 1:		
1. Uses safe practices and procedures.		
Criterion: No injury or damage results to individual(s) or the		
equipment and complies with OSHA regulations.		
2. Uses appropriate tools, equipment, and procedures.		
Criterion: Complies to directions on Job Sheet 1-6 and the manufacturer's		
directions for use of the equipment.		
3. Accurately takes and records and calculates		
temperatures in Fahrenheit and Centigrade.		
Criterion: Temperatures are to ± 1% of the actual temperature.		
Objective 2:		
4. Accurately calculates the number of BTU's needed		
to do a specified amount of work.		
Criterion: Accurate to ± 2% of the total per instructor's key.		

	CRITERION	
	Met	Not Met
Objective 3:		
5. Accurate identification of components on a simple		
refrigeration system.		
Criterion: Complies to the information listed in the text, Modern		
Refrigeration and Air Conditioning, pp. 477-481 (Compressors),		
pp. 483-485 (Condensers), pp. 625-626 (Evaporators)		
6. Completes the job in a reasonable time.		
Criterion: Not to exceed 2-1/2 hours.		
The student must complete 5 of the 6 line items satisfactorily		
to complete this test. You cannot miss Item #6.		

INSTRUCTOR'S CRITERION KEY

Line Item 4:

Answer Key: Question 1 = 2496 BTU
Question 2 - 2250 BTU

LAP TEST ANSWER KEY: ICE

1. D
2. B
3. C
4. C
5. A
6. D
7. A
8. C
9. A

LAP TEST ANSWER KEY: WATER EVAPORATION

1. A
2. B
3. A
4. B
5. D

1. D
2. A
3. B
4. A
5. C
6. A
7. A
8. A
9. D
10. A
11. A

LAP TEST ANSWER KEY: AUTO AIR CONDITIONING

1. B
2. C
3. A
4. B
5. D
6. B
7. B
8. A
9. C
10. D
11. D

UNIT TEST ANSWER KEY: BASIC REFRIGERATION SYSTEMS

LAP 01

1. D
2. B
3. C
4. [illegible] A
5. [illegible] B

LAP 02

6. A
7. B
8. A
9. [illegible] B
10. D

LAP 03

11. B
12. A
13. B
14. B
15. B

LAP 04

16. D
17. B
18. A
19. C & D
20. A
21. A
22. A
23. D
24. A
25. A

LAP 05

26. [illegible] B
27. [illegible] C
28. A
29. B
30. D
31. B
32. B
33. A
34. C
35. D

Family Education Program

File Code: 751.02.05.01

Date Published: 11/7/77

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: COMPRESSION CYCLE

INTRODUCTION:

This LAP covers compression cycles in rotary, reciprocating and centrifugal compressors. The only prerequisite is to have read and completed the previous LAPS.

REVIEW:

All compression type refrigeration systems use compressors of various shapes and sizes. A service technician must be acquainted with the operation of all of these units.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain a complete compression cycle.
2. Explain the major components of the compression system.
3. Identify major components and types of compressors.

ASSIGNMENT:

Study Chapter 4 in Modern Refrigeration and Air Conditioning, covering compression systems.

WRITTEN TEST:

When you have completed the assignment, take the written test. Upon successful completion, continue.

DEMONSTRATION:

None. Ask instructor for help if you have a problem.

Principal Author(s): John Carey

PERFORMANCE:

Go to the trainer and do experiment 10 on compressors in your lab manual. Be careful with the trainer. Make sure the right valves are opened. If you have problems, see your instructor for help.

EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor check over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. How a compression cycle works.
2. How compression systems differ with different refrigeration used.
3. What components are used to complete a typical compression cycle.

After successful completion, reocrd LAP on SPR and proceed to the next LAP.

Student: ______________________ **File Code:** 751.02.05.01

Date: ______________________ **Date Published:** 11/17/77

Family Education Program

LAP TEST: COMPRESSION CYCLE

1. What is the major component used in a compression cycle?

   a. a compressor.
   b. a defuser.
   c. a heat exchanger.
   d. an evaporator.

2. What four major components of a refrigeration system are used in a compression cycle?

   a. an evaporator, condenser, compressor, a metering device.
   b. an evaporator, condenser, low pressure switch, a metering device.
   c. a condenser, compressor, heat exchanger, a metering device.
   d. just your evaporator, condenser and compressor.

3. What does the compressor do?

   a. compresses high pressure liquid.
   b. compresses low pressure vapor.
   c. compresses high pressure vapor.
   d. compresses moisture from the system.

4. What is the purpose of a condenser?

   a. remove heat.
   b. add heat.
   c. hold refrigerant vapor.
   d. separate the compressor from the evaporator.

5. What is the purpose of an evaporator?

   a. to make the refrigerator cold.
   b. to absorb heat.
   c. to create a high pressure area for the refrigerant to flow from.
   d. to separate the condenser from the compressor.

File Code: 751.02.05.02

Date Published: 11/7/77

Family Education Program

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: TYPES OF COMPRESSORS

INTRODUCTION:

This LAP covers the different types of compressors used in a refrigeration system. The only prerequisite is to have read and completed successfully the previous LAP.

REVIEW:

There are several types of compressors used in refrigeration. A service technician needs to be able to identify the type being used and why it is being used.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain the operation of different types of compressors.
    A. Rotary
    B. Reciprocating
    C. Centrifugal
    D. Gear type
    E. Diaphragm type
2. Explain how and why the compressor operates the way it does.

ASSIGNMENT:

Study Chapter 4 in Modern Refrigeration and Air Conditioning, covering the various types of compressors.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

None.

Principal Author(s): John Carey

Family Training Center, Inc.

EVALUATION:

No Performance Test.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. What the difference is between the various types of compressors.
2. What type of system it would be used on.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ **File Code:** 751.02.05.02

Date: ______________________ **Date Published:** 11/17/77

Family Education Program

LAP TEST: TYPES OF COMPRESSORS

1. What type of compressors are quite similar in construction to a gasoline engine?

   a. rotary compressor.
   b. centrifugal compressor.
   c. diaphragm type.
   d. reciprocating compressor.

2. What type of compressor uses an eccentric shaft and blades?

   a. a centrifugal.
   b. a rotary.
   c. a reciprocating.
   d. a diaphragm type.

3. When is a centrifugal compressor used?

   a. in large air conditioning installations.
   b. on large walk-in coolers.
   c. on automobile air conditioners.
   d. in domestic refrigeration equipment.

4. What two types of compressors are found to be impractical due to fine tolerances needed to maintain pumping efficiency?

   a. reciprocating and centrifugal.
   b. rotary and gear type.
   c. gear and diaphragm type.
   d. rotary and diaphragm type.

5. What type of compressor is most commonly used in the refrigeration industry?

   a. rotary.
   b. reciprocating.
   c. centrifugal.
   d. diaphragm.

Family Education Program

File Code: 751.02.05.03

Date Published: 11/7/77

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: COMPRESSOR CONSTRUCTION

INTRODUCTION:

This LAP covers compressor construction. It will give you a better understanding of the components used in a compressor and how they operate. The only prerequisite is to have read and completed successfully the previous LAP.

REVIEW:

The different compressors use different mechanical means to compress the refrigerant. To be able to identify one type of compressor from another, and service them, you should know the components of each.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain the components used in various types of compressors and their function.
2. Be able to answer test questions correctly.

ASSIGNMENT:

Study Chapter 5 in Modern Heating and Air Conditioning, covering compressor construction.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

None.

Principal Author(s): John Carey

EVALUATION:

This LAP has no Performance Test.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. What components make up each type of compressor.
2. How they are assembled.
3. What work they perform.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ File Code: 751.02.05.03

Date: ______________________ Date Published: 11/17/77

Family Education Program

LAP TEST: CONSTRUCTION

1. On reciprocating compressors what are the gaskets made out of?

   a. paper and lead.
   b. plastic and cork.
   c. cork and lead.
   d. paper and cork.

2. What type of material are the cylinder and heads of a reciprocating compressor made of?

   a. cast iron and cast steel.
   b. aluminum.
   c. a combination of copper and aluminum.
   d. brass and aluminum.

3. What type of material is used on compressors used in automobile air conditioning systems?

   a. teflon coated.
   b. synthetic rubber seal.
   c. graphite seal.
   d. bronze seal.

4. What type of material is used in a compressor valve?

   a. cast iron.
   b. thin copper discs.
   c. thin steel discs.
   d. aluminum discs.

5. What type of compressor operates with revolving circular impellers connected in multiple stages?

   a. reciprocating.
   b. centrifugal.
   c. rotary.
   d. gear type compressor.

EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. Why a compressor must be properly lubricated.
2. What different types of refrigeration oils are used.
3. How to change oil in a compressor.

After successful completion, record LAP on SPR. Study all of Unit IV, prepare for your Unit Performance and written test. Notify your instructor when you are ready to take the test. After passing the test, record your score on SPR and notify your instrcutor when you are ready to take the Performance Test. After successful completion, go on to your next Unit and LAP.

Student: ____________________ File Code: 751.02.05.04

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST: LUBRICATION

1. What are the two ways compressors are lubricated?

   a. by a splash system or by a pressure feed system.
   b. by centrifugal force and a splash system.
   c. by centrifugal force and by an oil filter.
   d. by hydraulic pressure and a pressure force feed system.

2. In a force feed or pressure system, what is used to move the oil?

   a. small oil pump.
   b. a transfer motor.
   c. an oil diverter.
   d. an oil separator.

3. What is used to prevent excess oil pressure in the system?

   a. an overload release valve.
   b. a high pressure kick out switch.
   c. a temperature pressure release valve.
   d. a safety release valve.

4. What are the requirements of a good lubricant for refrigeration equipment?

   a. must be moisture free, wax free and unfoaming.
   b. it has to be a synthetic oil.
   c. it must be heat treated, wax free and free of impurities.
   d. it is a combination of synthetic and low on viscosity oil.

5. What type of oil is used in a sealed system?

   a. 10 weight.
   b. multi weight.
   c. high detergent.
   d. special prepared mineral oil.

Student: ______________________ **File Code:** 751.02.05.00

Date: ______________________ **Date Published:** 2-20-78

Family Education Program

UNIT TEST: COMPRESSION SYSTEM AND COMPRESSORS

75.02.05.01

1. What is the major component used in a compression cycle?

   a. compressor.
   b. a defuser.
   c. a heat exchanger.
   d. an evaporator.

2. What four major components of a refrigeration system are used in a compression cycle?

   a. an evaporator, condenser, compressor, a metering device.
   b. an evaporator, condenser, low pressure switch, a metering device.
   c. a condenser, compressor, heat exchanger, a metering device.
   d. just your evaporator, condenser and compressor.

3. What does the compressor do?

   a. compresses high pressure liquid.
   b. compresses low pressure vapor.
   c. compresses high pressure vapor.
   d. compresses moisture from the system.

4. What is the purpose of a condenser?

   a. remove heat.
   b. add heat.
   c. hold refrigerant vapor.
   d. separate the compressor from the evaporator.

5. What is the purpose of an evaporator?

   a. to make the refrigerator cold.
   b. to absorb heat.
   c. to create a high pressure area for the refrigerant to flow from.
   d. to separate the condenser from the compressor.

75.02.05.02

6. What type of compressors are quite similar in construction to a gasoline engine?

   a. rotary compressor.
   b. centrifugal compressor.
   c. diaphragm type.
   d. reciprocating compressor.

75.02.05.02 (continued)

7. What type of compressor uses an eccentric shaft and blades?

   a. a centrifugal.
   b. a rotary.
   c. a reciprocating.
   d. a diaphragm type.

8. When is a centrifugal compressor used?

   a. in large air conditioning installations.
   b. on large walk-in coolers.
   c. on automobile air conditioners.
   d. in domestic refrigeration equipment.

9. What twyo types of compressors are found to be impractical due to fine tolerances needed to maintain pumping efficiency?

   a. reciprocating and centrifugal.
   b. rotary and gear type.
   c. gear and diaphragm type.
   d. rotary and diaphragm type.

10. What type of compressor is most commonly used in the refrigeration industry?

    a. rotary.
    b. reciprocating.
    c. centrifugal.
    d. diaphragm.

75.02.05.03

11. On reciprocating compressors what are the gaskets made out of?

    a. paper and lead.
    b. plastic and cork.
    c. cork and lead.
    d. paper and cork.

12. What type of material are the cylinder and heads of a reciprocating compressor made of?

    a. cast iron and cast steel.
    b. aluminum.
    c. a combination of copper and aluminum.
    d. brass and aluminum.

13. What type of material is used on compressors used in automobile air conditioning systems?

    a. teflon coated.
    b. synthetic rubber seal.
    c. graphite seal.
    d. bronze seal.

75.02.05.03 (continued)

14. What type of material is used in a compressor valve?

    a. cast iron.
    b. thin copper discs.
    c. thin steel discs.
    d. aluminum discs.

15. What type of compressor operates with revolving circular impellers connected in multiple stages?

    a. reciprocating.
    b. centrifugal.
    c. rotary.
    d. gear type compressor.

75.02.05.04

16. What are the two ways compressors are lubricated?

    a. by a splash system or by a pressure feed system.
    b. by centrifugal force and a splash system.
    c. by centrifugal force and by an oil filter.
    d. by hydraulic pressure and a pressure force feed system.

17. In a force feed or pressure system, what is used to move the oil?

    a. small oil pump.
    b. a transfer motor.
    c. an oil diverter.
    d. an oil separator.

18. What is used to prevent excess oil pressure in the system?

    a. an overload release valve.
    b. a high pressure kick out switch.
    c. a temperature pressure release valve.
    d. a safety release valve.

19. What are the requirements of a good lubricant for refrigeration equipment?

    a. must be moisture free, wax free and unfoaming.
    b. it has to be a synthetic oil.
    c. it must be heat treated, wax free and free of impurities.
    d. it is a combination of synthetic and low on viscosity oil.

20. What type of oil is used in a sealed system?

    a. 10 weight.
    b. multi weight.
    c. high detergent.
    d. special prepared mineral oil.

Student: ____________________ File Code: 751.02.05.00

Date: ____________________ Date Published: 1-27-78

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

UNIT PERFORMANCE TEST: COMPRESSION SYSTEM AND COMPRESSORS

OBJECTIVE 1:

Using appropriate tools, equipment, supplies, and procedures, troubleshoot, repair, and service a residential central cooling system.

TASK:

Given a residential central cooling system, that is inoperable, the student must troubleshoot, repair and service the system, using appropriate tools, equipment, supplies, and repair procedures.

ASSIGNMENT:

CONDITIONS:

The troubleshooting, repair and service of a residential central comfort cooling system will be accomplished on a real system. He will be allowed to use all the equipment, tools, and resource materials commonly found in a typical repair shop. The student will not be allowed to obtain any assistance from the instructor or other students. The job must be completed within the time indicated.

RESOURCES:

Printed Material:
Modern Refrigeration and Air Conditioning, Althouse

Equipment:
one central air conditioner installed in furnace.

RESOURCES: (Cont.)

Tools:
- 1 1/4" ratchet wrench
- 1 Set open end wrenches
- 1 8" adj. wrench
- 1 Spout can of oil
- 1 Pair safety goggles
- 1 6" screwdriver - 1/4" blade
- 1 #2 Phillips screwdriver
- 1 Set of valve adapters

Instruments:
- 1 Gauge manifold, complete
- 1 Thermometer
- 1 Vacuum pump
- 1 Electrical analyzer

Supplies:
- 1 Wiping cloth
- 1 1 to 5 lb. refrigerant service cylinder

ASSIGNMENT SHEET

OBJECTIVE 1:

1. Test external circuit first: Power in, thermostat, relay, capacitor, overload protector, motor compressor, filter, air flow, condensate drain, fresh air supply, and condenser cooling medium.

2. Install gauges, check pressures, and test for leaks.

3. Run the unit for at least fifteen minutes. Check the TEV operation, condenser condition, fans and motors and temperatures.

4. If the unit is frosting, the TEV may be leaking, the thermostat is not shutting off, or the TEV bulb is loose.

5. If the coil is starved, the valve may be partially clogged with moisture, or dirt, or the screen may be partially clogged, or there may be a lack of refrigerant.

6. Repair what is necessary. Remove the refrigerant from the part to be repaired. BE CAREFUL! Replace the worn part and assemble the unit. Evacuate the air, charge, and test for leaks.

	At the Beginning	After 15 Minutes	After Repair
Low Side Pressure			
High Side Pressure			
Suction Line Temp., Approx.			
Liquid Line Temp., Approx.			
Evaporator Temperature			
Noise, Compressor			
Motor			

Remarks:

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

Student: ____________________ File Code: 751.02.05.00

Date: ____________________ Date Published: 11/15/74

FAMILY PAY NUMBER: __________ SEX: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory _____ Unsatisfactory _____

	CRITERION Met	 Not Met
Objective 1:		
1. Properly corrects all electrical malfunctions:		
(thermostat, relay, capacitor overload protector,		
motor compressor, etc.)		
Criterion: Electrical system functions according to the		
manufacturer's specifications.		
2. Installs gauges properly.		
Criterion: Modern Refrigeration and Air Conditioning,		
paragraph 12-17.		
3. Accurately checks and records pressures.		
Criterion: System pressures compare to the manufacturer's		
specifications.		
4. Accurately takes and records temperatures.		
Criterion: Recorded temperatures compare to the		
manufacturer's specifications.		

(Checklist continued)

	CRITERION	
	Met	Not Met
5. When applicable, student correctly services and repairs TEV valve (Thermostatic Expansion Valve).		
Criterion: Valve operates according to the manufacturer's specifications.		
6. Uses appropriate tools, equipment, and procedures.		
Criterion: System operates according to specifications.		
7. Follows appropriate safety practices and procedures.		
Criterion: Complies with OSHA regulations and no injury results.		
8. Work is neat and presentable.		
Criterion: No visible damage results to the equipment and assembled parts are installed to manufacturer's specifications.		
9. All mechanical fastenings are correct.		
Criterion: System is assembled to manufacturer's specifications.		
10. All data is filled out on the Assignment Sheet.		
Criterion: Assignment Sheet and no data is missing.		
11. Gas is installed properly if needed.		
Criterion: System functions to the manufacturer's specifications.		
12. The job is completed in a reasonable time.		

(Checklist continued)

	CRITERION	
	Met	Not Met
Criterion: Not to exceed 8 hours.		
The student must complete all of the line items to pass this test.		

LAP TEST ANSWER KEY: TYPES OF COMPRESSORS

1. D
2. B
3. A
4. C
5. B

LAP TEST ANSWER KEY: COMPRESSOR CONSTRUCTION

1. A
2. A
3. A
4. C
5. B

LAP TEST ANSWER KEY: LUBRICATION

1. A
2. A
3. D
4. A
5. D

UNIT TEST ANSWER KEY: COMPRESSION SYSTEM AND COMPRESSORS

LAP 01

1. A
2. A
3. B
4. A
5. B

LAP 02

6. D
7. B
8. A
9. [illegible] B
10. B

LAP 03

11. A
12. A
13. A
14. C
15. B

LAP 04

16. A
17. A
18. D
19. A
20. D

Family Education Program

File Code: 751.02.06.01

Date Published: 11/7/77

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: CAPILLARY TUBE

INTRODUCTION:

This LAP covers the capillary tube metered refrigeration system. The only prerequisite is to have read and completed the previous units successfully.

REVIEW:

Capillary tube systems are used on almost all domestic refrigeration systems. It is a low cost, reliable metering device. Proper operation and uses are needed for the unit to give satisfactory service.

COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Explain how a capillary tube system works.
2. Perform an experiment on a capillary system.

ASSIGNMENT:

Study Chapter 6 in Modern Heating and Air Conditioning, covering capillary tube systems. Go over the capillary tube system in your lab manual, experiment 6.

WRITTEN EVALUATION:

When you have completed the assignment, take the written test. Upon successful completion, continue.

DEMONSTRATION:

None.

Principal Author(s): John Carey

PERFORMANCE:

After you have read experiment 6, perform the experiment on the trainer. Be careful when operating the trainer. If you run into trouble, ask your instructor for help.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor check over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. How a capillary tube system operates.
2. How the size of a capillary tube affects the sytems.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ File Code: 751.02.06.01

Date: ______________________ Date Published: Nov. 17,1977

Family Education Program

LAP TEST: CAPILLARY TUBE

1. What is the purpose of a capillary tube?

   a. It separates the high side from the low side.
   b. It is a metering device for refrigerant.
   c. It is used to create a high pressure area.
   d. It controls the temperature of the evaporator in the system.

2. What are the four variables that affect the metering qualities of a capillary tube?

   a. Tube length, inside diameter, tightness of tube windings, and amount of refrigerant.
   b. Tube length, inside diameter, tightness of windings, temperature of tubing.
   c. Inside diameter, tube length, temperature of tubing, and material used for the capillary tube.
   d. Tube length, inside diameter, temperature of tubing, and size of the dryer.

3. What type of device was used by Frigidaire to take the place of a capillary tube?

   a. A refractor.
   b. A restricter.
   c. A reducer.
   d. A refrigerant contacter.

4. How many moving parts are there in a capillary tube?

   a. 1
   b. 2
   c. 3
   d. None.

5. What is the most popular method of fastening the capillary tube to the evaporator and condenser?

   a. Mechanically.
   b. Silver braised.
   c. Epoxy.
   d. The 50/50 solder.

6. What is the biggest problem encountered with capillary tubes?

   a. Restrictions.
   b. They wear out fast.
   c. They leak easily.
   d. They are hard to silver solder.

7. What will happen to a capillary tube if there is moisture in the system?

   a. Nothing.
   b. It will overheat the system.
   c. The moisture will form ice and cause blockage.
   d. The moisture will clean the wax from the cap tube.

8. What is the capillary tube made from?

   a. Seamless copper.
   b. Seamless steel.
   c. Teflon-coated copper.
   d. Plastic material.

Family Education Program

File Code: 751.02.06.02

Date Published: 11/7/77

Learning Activity Package

Student: ______

Date: ______

PERFORMANCE ACTIVITY: AUTOMATIC EXPANSION VALVE

INTRODUCTION:

This LAP covers the operation of the automatic expansion valve. The only prerequisite is to have read and completed the previous LAP successfully.

REVIEW:

The automatic expansion valve is a metering device used in a typical refrigeration system. The operations and functions are needed to be known, to accurately troubleshoot a sealed system using this type of metering device.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain how the automatic expansion valve operates.
2. Change a valve correctly.
3. Perform an experiment using an automatic expansion valve.

ASSIGNMENT:

Study Chapter 6 in Modern Refrigeration and Air Conditioning, covering automatic expansion valves. Read over experiment 7 in your lab manual.

WRITTEN EVALUATION:

When you have completed the assignment, take the written test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

When you feel you understand experiment 7, perform experiment 7 on the trainer. Be careful when using the trainer. If you have any questions or run into problems, ask your instructor for help before proceeding.

Principal Author(s): John Carey

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor check over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. How an automatic expansion valve operates.
2. How it is used in a system.
3. How to check for a malfunctioning valve.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ File Code: 751.02.06.02

Date: ______________________ Date Published: Nov. 17,1977

Family Education Program

LAP TEST: AUTOMATIC EXPANSION VALVE

1. What is the purpose of an automatic expansion valve?

    a. It separates the high side from the low side.
    b. It creates a low pressure area on the high side.
    c. It throttles the liquid refrigerant.
    d. It separates the evaporator from the condenser.

2. How is an automatic expansion valve operated?

    a. By the low side pressure of the system.
    b. By the high side pressure of the system.
    c. By the amount of refrigerant in the receiver.
    d. By a combination of temperature, pressure and compresser reversing action.

3. Name two types of automatic expansion valves?

    a. Bellow type and pressure type.
    b. Diaphragm and pressure type.
    c. Diaphragm and bellow type.
    d. Diaphragm and resistance type.

4. What type of automatic expansion valve do you use when you want the pressures in the system to equalize when the system cycle is off?

    a. Diaphragm type.
    b. Bypass automatic expansion valve.
    c. Bellow type.
    d. Electrically controlled type.

5. What can cause an automatic expansion valve to fail?

    a. Low suction pressure.
    b. High suction pressure.
    c. The needle and seat may leak.
    d. Low condenser pressure.

6. When you have a leaky valve, what are the symptoms?

    a. Frosting of the suction line.
    b. Extremely high head pressure.
    c. Higher than normal low side pressure.
    d. Low amp pull.

Family Education Program

File Code: 751.02.06.03

Date Published: 11/7/77

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: THERMOSTATIC EXPANSION VALVES

INTRODUCTION:

This LAP covers the thermostatic expansion valve used in a typical refrigeration system. The only prerequisite is to have read and completed the previous LAP successfully.

REVIEW:

Thermostatic expansion valves are used mainly on commercial units, but can be found on heat pumps and other domestic units. They are about the most efficient expansion valve.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain the operation of a thermostatic expansion valve.
2. Be able to answer all questions concerning a thermostatic expansion valve.
3. Change a thermostatic expansion valve.

ASSIGNMENT:

Study Chapters 6, 13 and 15 in Modern Refrigeration and Air Conditioning, covering thermostatic expansion valves. Read over experiment 8 in your lab manual.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

When you are sure you understand experiment 8 in your lab manual, start the experiment on the trainer. If for any reason, you run into trouble, ask your instructor for help before proceeding. Be very careful working around refrigerant and the trainer. Complete all questions in the lab manual.

Principal Author(s): John Carey

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor check over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. How a TXV functions.
2. How it compares to other valves.
3. How to troubleshoot it.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ File Code: 751.02.06.03

Date: ______________________ Date Published: Nov. 17,1977

Family Education Program

LAP TEST: THERMOSTATIC EXPANSION VALVES

1. In a thermostatic expansion valve, what determines the rate of flow of refrigerant through the valve into the evaporator?

   a. By the pressure in the evaporator and the temperature of the evaporator coil outlet.
   b. By the high side pressure and the temperature of the evaporator coil outlet.
   c. By the high and low side pressures.
   d. By the low side pressure and the evaporator pressure.

2. What is the power element filled with?

   a. Mercury.
   b. R-11.
   c. Same type of refrigerant used in the system.
   d. Methane gas.

3. Where should the bulb in the thermostatic expansion valve be located?

   a. Near the inlet of the evaporator.
   b. Near the outlet of the evaporator.
   c. In the middle of the evaporator.
   d. Just before the metering device.

4. How many types of charges are there in the power element of the termostatic expansion valve?

   a. 1
   b. 2
   c. 4
   d. 6

5. How are thermostatic expansion valves rated?

   a. In pounds per square inch.
   b. In tons.
   c. In BTUs.
   d. In super heat.

6. What is an equalizer tube used with the thermostatic expansion valve?

   a. On any unit larger than 3 tons.
   b. On any unit larger than 5 tons.
   c. If there is more than a 4 PSI between the inlet of the evaporator and outlet.
   d. If there is more than a 10 PSI between the inlet and the outlet of the evaporator.

Family Education Program

File Code: 751.02.06.04

Date Published: 11/7/77

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: CHECK VALVES

INTRODUCTION:

This LAP covers check valves used in a typical refrigeration system. The only prerequisite is to have read and completed successfully the previous LAPS.

REVIEW:

Check valves are used in refrigeration systems to control the direction of flow of refrigerant in a system. Proper installation is needed for correct operation of the unit.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Correctly install a check valve.
2. Answer all test questions correctly.
3. Explain the operation and function of a check valve.

ASSIGNMENT:

Study Chpater 6 in Modern Refrigeration and Air Conditioning, covering check valves.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

None.

Principal Author(s): John Carey

Family Training Center, Inc.

PERFORMANCE EVALUATION:

There is no Performance Evaluation for this LAP.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. The importance of correct installation.
2. How the check valve works.

After successful completion, record LAP on SPR and proceed to the next LAP.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. What a solenoid valve is.
2. How it works.
3. How to change valve if defective.

After successful completion, record LAP on SPR and proceed to the next LAP.

File Code: 751.02.06.04/.05/.06

Date Published: 11/7/77

Family Education Program

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: PRESSURE VALVES

INTRODUCTION:

This LAP covers pressure valves used in a typical refrigeration system. The only prerequisite is to have read and completed the previous LAP successfully.

REVIEW:

Pressure valves are used to maintain certain minimum pressure in the system. If they are not working properly, efficiency goes down and the unit may not continue to function. A good technician must know how they work and how to check them for proper operation.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain how a pressure valve operates.
2. Troubleshoot a valve.
3. Change a valve.
4. Answer test questions correctly.

ASSIGNMENT:

Study Chapter 6 in Modern Refrigeration and Air Conditioning, covering pressure valves. Read experiment 18 in your lab manual.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

Perform experiment 18 in the lab manual. Be sure to answer all questions on experiment 18 in your lab manual. Always be careful working with all trainers in the area. If you run into problems, be sure to get help from your instructor before proceeding.

Principal Author(s): John Carey

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. What a pressure valve is.
2. How it works.
3. How to change a defective one.

After successful completion, record LAP on SPR and review the LAPS in this unit on Refrigeration Controls. Study for the Unit Written and Performance Tests. Tell your instructor when you are ready to take the tests.

Student: ______________________ File Code: 751.02.06.04/.05/.06

Date: ______________________ Date Published: 11/17/77

Family Education Program

LAP TEST: CHECK, SOLENOID, AND PRESSURE VALVES

1. What do rotary and gear type compressors used in the suction line to prevent backing up of the high pressure vapor?

   a. solenoid valves.
   b. check valves.
   c. pressure valves.
   d. expansion valves.

2. How many types of check valves are there?

   a. 2, disc and solid ball.
   b. 3, disc, solid ball and square type.
   c. just one, disc type.
   d. just one, solid ball type.

3. What does the solenoid valve consist of?

   a. wire stem.
   b. magnet with moveable core.
   c. case and plunger.
   d. inlet and outlet openings.

4. How many types of solenoid are in common use?

   a. 3
   b. 2
   c. 1
   d. 7

5. What type of system uses a 4-way reversing valve?

   a. walk-in cooler.
   b. air conditioner system.
   c. heat pump.
   d. ice maker.

6. When a 4-way valve is de-energized, in what mode is the heat pump?

   a. in the cooling mode.
   b. in the heating mode.
   c. in neither mode.
   d. in the defrost cycle.

7. In what position should the solenoid valve be located?

   a. in a level, upright position.
   b. so the solenoid is in a horizontal position.
   c. it doesn't matter what position the valve is in.
   d. it should be mounted for easy access.

8. For what is a pressure operated water valve used?

   a. in domestic refrigeration.
   b. in the commercial refrigeration field.
   c. in industrial refrigeration.
   d. in all types of refrigeration.

9. As pressure increases in the system, what happens to the valve?

   a. it closes.
   b. it opens.
   c. it isn't affected by pressure.
   d. it depends on the altitude.

10. When replacing a solenoid valve, what are two things to check for?

    a. the correct voltage and the correct color coding.
    b. the correct voltage and the correct amperage.
    c. the correct amperage and the correct pressure setting.
    d. the pressure setting and the correct color coding.

Student: ______________________ **File Code:** 751.02.06.00

Date: ______________________ **Date Published:** 2-20-78

Family
Education
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UNIT TEST: REFRIGERATION CONTROLS

75.02.06.01

1. What is the purpose of a capillary tube?
   a. it separates the high side from the low side.
   b. it is a metering device for refrigerant.
   c. it is used to create a high pressure area.
   d. it controls the temperature of the evaporator in the system.

2. What are the four variables that affect the metering qualities of a capillary tube?
   a. tube length, inside diameter, tightness of tube windings, and amount of refrigerant.
   b. tube length, inside diameter, tightness of windings, temperature of tubing.
   c. inside diameter, tube length, temperature of tubing, and material used for the capillary tube.
   d. tube length, inside diameter, temperature of tubing, and size of the dryer.

3. How many moving parts are there in a capillary tube?
   a. 1
   b. 2
   c. 3
   d. none.

4. What is the biggest problem encountered with capillary tubes?
   a. restrictions.
   b. they wear out fast.
   c. they leak easily.
   d. they are hard to silver solder.

5. What will happen to a capillary tube if there is moisture in the system?
   a. nothing.
   b. it will overheat the system.
   c. the moisture will form ice and cause blockage.
   d. the moisture will clean the wax from the cap tube.

75.02.06.02

6. What is the purpose of an automatic expansion valve?

   a. it separates the high side from the low side.
   b. it creates a low pressure area on the high side.
   c. it throttles the liquid refrigerant.
   d. it separates the evaporator from the condenser.

7. Name two types of automatic expansion valves?

   a. bellow type and pressure type.
   b. diaphragm and pressure type.
   c. diaphragm and bellow type.
   d. diaphragm and resistance type.

8. What type of automatic expansion valve do you use when you want the pressures in the system to equalize when the system cycle is off?

   a. diaphragm type.
   b. bypass automatic expansion valve.
   c. bellow type.
   d. electrically controlled type.

9. What can cause an automatic expansion valve to fail?

   a. low suction pressure.
   b. high suction pressure.
   c. the needle and seat may leak.
   d. low condenser pressure.

10. When you have a leaky valve, what are the symptoms?

   a. frosting of the suction line.
   b. extremely high head pressure.
   c. higher than normal low side pressure.
   d. low amp pull.

75.02.06.03

11. What is the power element filled with?

   a. mercury.
   b. R-11.
   c. same type of refrigerant used in the system.
   d. methane gas.

12. Where should the bulb in the thermostatic expansion valve be located?

   a. near the inlet of the evaporator.
   b. near the outlet of the evaporator.
   c. in the middle of the evaporator.
   d. just before the metering device.

75.02.06.03 (continued)

13. How many types of charges are there in the power element of the thermostatis expansion valve?

a. 1
b. 2
c. 4
d. 6

14. How are thermostatic expansion valves rated?

a. in pounds per square inch.
b. in tons.
c. in BTU's.
d. in super heat.

15. What is an equalizer tube used with the thermostatic expansion valve?

a. on any unit larger than 3 tons.
b. on any unit larger than 5 tons.
c. if there is more than a 4 PSI between the inlet of the evaporator and outlet.
d. if there is more than a 10 PSI between the inlet and the outlet of the evaporator.

75.02.06.04 & .05 & .06

16. What do rotary and gear type compressors used in the suction line to prevent backing up of the high pressure vapor?

a. solenoid valves.
b. check valves.
c. pressure valves.
d. expansion valves.

17. How many types of check valves are there?

a. 2, disc and solid ball.
b. 3, disc, solid ball and square type.
c. just one, disc type.
d. just one, solid ball type.

18. What does the solenoid valve consist of?

a. wire stem.
b. magnet with moveable core.
c. case and plunger.
d. inlet and outlet openings.

19. How many types of solenoid are in common use?

a. 3
b. 2
c. 1
d. 7

75.02.06.04 & .05 & .06 (continued)

20. What type of system uses a 4-way reversing valve?

    a. walk-in cooler.
    b. air conditioner system.
    c. heat pump.
    d. ice maker.

21. When a 4-way valve is de-energized, in what mode is the heat pump?

    a. in the cooling mode.
    b. in the heating mode.
    c. in neither mode.
    d. in the defrost cycle.

Student: ______________________ File Code: 751.02.06.00

Date: ______________________ Date Published: 1-27-78

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

UNIT PERFORMANCE TEST: REFRIGERATION CONTROLS

OBJECTIVE 1:

Using appropriate tools, equipment, supplies, and procedures, troubleshoot, repair, and service a residential central cooling system.

TASK:

Given a residential central cooling system, that is inoperable, the student must troubleshoot, repair and service the system, using appropriate tools, equipment, supplies, and repair procedures.

ASSIGNMENT:

CONDITIONS:

The troubleshooting, repair and service of a residential central comfort cooling system will be accomplished on a real system. He will be allowed to use all the equipment, tools, and resource materials commonly found in a typical repair shop. The student will not be allowed to obtain any assistance from the instructor or other students. The job must be completed within the time indicated.

RESOURCES:

Printed Material:
Modern Refrigeration and Air Conditioning, Althouse

Equipment:
one central air conditioner installed in furnace.

RESOURCES: (Cont.)

Tools:
1 1/4" ratchet wrench
1 Set open end wrenches
1 8" adj. wrench
1 Spout can of oil
1 Pair safety goggles
1 6" screwdriver - 1/4" blade
1 #2 Phillips screwdriver
1 Set of valve adapters

Instruments:
1 Gauge manifold, complete
1 Thermometer
1 Vacuum pump
1 Electrical analyzer

Supplies:
1 Wiping cloth
1 1 to 5 lb. refrigerant service cylinder

ASSIGNMENT SHEET

OBJECTIVE 1:

1. Test external circuit first: Power in, thermostat, relay, capacitor, overload protector, motor compressor, filter, air flow, condensate drain, fresh air supply, and condenser cooling medium.
2. Install gauges, check pressures, and test for leaks.
3. Run the unit for at least fifteen minutes. Check the TEV operation, condenser condition, fans and motors and temperatures.
4. If the unit is frosting, the TEV may be leaking, the thermostat is not shutting off, or the TEV bulb is loose.
5. If the coil is starved, the valve may be partially clogged with moisture, or dirt, or the screen may be partially clogged, or there may be a lack of refrigerant.
6. Repair what is necessary. Remove the refrigerant from the part to be repaired. BE CAREFUL! Replace the worn part and assemble the unit. Evacuate the air, charge, and test for leaks.

	At the Beginning	After 15 Minutes	After Repair
Low Side Pressure			
High Side Pressure			
Suction Line Temp., Approx.			
Liquid Line Temp., Approx.			
Evaporator Temperature			
Noise, Compressor			
Motor			

Remarks:

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

Student: ______________________ **File Code:** 751.02.06.00

Date: ______________________ **Date Published:** 11/15/74

FAMILY PAY NUMBER:__________ SEX: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory_____ Unsatisfactory_____

	CRITERION	
	Met	Not Met
Objective 1:		
1. Properly corrects all electrical malfunctions:		
(thermostat, relay, capacitor overload protector,		
motor compressor, etc.)		
Criterion: Electrical system functions according to the		
manufacturer's specifications.		
2. Installs gauges properly.		
Criterion: Modern Refrigeration and Air Conditioning,		
paragraph 12-17.		
3. Accurately checks and records pressures.		
Criterion: System pressures compare to the manufacturer's		
specifications.		
4. Accurately takes and records temperatures.		
Criterion: Recorded temperatures compare to the		
manufacturer's specifications.		

	CRITERION	
	Met	Not Met
5. When applicable, student correctly services and repairs TEV valve (Thermostatic Expansion Valve).		
Criterion: Valve operates according to the manufacturer's specifications.		
6. Uses appropriate tools, equipment, and procedures.		
Criterion: System operates according to specifications.		
7. Follows appropriate safety practices and procedures.		
Criterion: Complies with OSHA regulations and no injury results.		
8. Work is neat and presentable..		
Criterion: No visible damage results to the equipment and assembled parts are installed to manufacturer's specifications.		
9. All mechanical fastenings are correct.		
Criterion: System is assembled to manufacturer's specifications.		
10. All data is filled out on the Assignment Sheet.		
Criterion: Assignment Sheet and no data is missing.		
11. Gas is installed properly if needed.		
Criterion: System functions to the manufacturer's specifications.		
12. The job is completed in a reasonable time.		

(Checklist continued)

	CRITERION	
	Met	Not Met
Criterion: Not to exceed 8 hours.		
The student must complete all of the line items to pass this		
test.		

LAP TEST ANSWER KEY: CAPILLARY TUBE

1. B
2. B
3. B
4. D
5. B
6. A
7. C
8. A

LAP TEST ANSWER KEY: AUTOMATIC EXPANSION VALVE

1. C
2. A
3. C
4. B
5. C
6. A

LAP TEST ANSWER KEY: THERMOSTATIC EXPANSION VALVE

1. A
2. C
3. B
4. C
5. B
6. C

LAP TEST ANSWER KEY: VALVES; CHECK, SOLENOID, PRESSURE

1. B
2. A
3. B
4. A
5. C
6. A
7. A
8. D
9. B
10. B

UNIT TEST ANSWER KEY: REFRIGERATION CONTROLS

LAP 01

1. B
2. B
3. D
4. A
5. C

LAP 02

6. C
7. C
8. B
9. C
10. A

LAP 03

11. C
12. B
13. C
14. B
15. C

LAP 04

16. B
17. A
18. B
19. A
20. C
21. A

File Code: 751.02.07.01

Date Published: 11/29/77

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: MOTOR CYLCING

INTRODUCTION:

This LAP covers the various types of motors used in refrigeration systems and how they cycle. The prerequisite is to have read and completed the previous LAP successfully.

REVIEW:

Refrigeration units use various motors for different purposes (all of which wear out and cause trouble). To be able to repair this equipment, a technician must know how these motors operate and what they are used for.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain how a motor operates.
2. Check a motor for proper operation.
3. Check a start and run capacitor.
4. Replace a motor.

ASSIGNMENT:

Study Chapter 7 in Modern Refrigeration and Air Conditioning, covering electric motors. Read over experiments 10, 12 and 13 in your lab manual.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

Check the central air conditioner, to make certain the power is shut off. With the power off, carefully remove the condenser fan motor. After removal, have the instructor check the unit. After complete disassembly, with approval of the instructor, reassemble the unit. Be careful when working with the equipment. Ask for help when needed.

Principal Author(s): John Carey

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. The various types of motor used.
2. How they operate.
3. How they are serviced and repaired, or replaced.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ____________________ File Code: 751.02.07.01

Date: ____________________ Date Published: 11/17/77

Family
Education
Program

LAP TEST: MOTOR CYCLING

1. Name two (2) types of motor cycling controls.

   a. thermostats and pressure switches.
   b. pressure switches and momentary overrides.
   c. thermostats and fuser contacts.
   d. capillary tubes switches and high frequency interference switches.

2. What is the most common type of thermostat?

   a. bi-metal strip.
   b. series wound resistance strip.
   c. high pressure overload switch.
   d. low pressure relay overload control inductor switch.

3. What does a diaphragm low pressure switch used to sense the temperature?

   a. thermocouple.
   b. a sensing bulb.
   c. inductance tube.
   d. heat coil.

4. On a thermostat, what does a differential adjustment control screw do?

   a. it adjusts the humidity control.
   b. the temperature between cut-out and cut-in.
   c. the super-heat cut-in and cut-out.
   d. it adjusts the on time of the compressor.

5. What is the purpose of the altitude adjustment control?

   a. it affects the thermostat used in commercial airplanes that are carrying refrigeration equipment.
   b. it is only used in walk-in cooler.
   c. it is used to adjust the cold control to various altitudes.
   d. it anticipates altitude change.

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Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: STARTING RELAYS AND OVERLOADS

INTRODUCTION:

This LAP covers starting relays and overloads used on a typical domestic refrigeration unit. The prerequisite is to have read and completed the previous LAP successfully.

REVIEW:

Starting relays and overloads are very important motor controls and can cause a lot of problems for a technician. Many compressors have been changed needlessly because of a faulty relay or overload that wasn't working properly.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain how the different types of relays work.
2. Check relay and overload devices for proper operation.
3. Replace a relay and overload device.

ASSIGNMENT:

Study Chapter 8 in Modern Refrigeration and Air Conditioning, covering relay and overloads.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

Get the relay analyzer out of the tool cabinet and have your instructor give you a relay to check. Before using the analyzer, read all instructions over very carefully. Make sure you understand how it works before checking the relay.

Principal Author(s): John Carey

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. Why a relay and overload are used.
2. How it operates.
3. How to check it.
4. The different types used.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ **File Code:** 751.02.07.02

Date: ______________________ **Date Published:** 11/17/77

Family Education Program

LAP TEST: RELAYS AND OVERLOADS

1. How many types of starting relays are used in refrigeration?

   a. 2
   b. 3
   c. 4
   d. 6

2. Which type of relay is not a magnetic relay?

   a. a current type.
   b. a potential type.
   c. a thermo type.
   d. a resistance type.

3. Which type of relay works off voltage?

   a. current type.
   b. thermo type.
   c. potential type.
   d. resistance type.

4. Which type starting relay has electric heaters built into it?

   a. thermo type.
   b. potential type.
   c. current type.
   d. resistance type.

5. When a service technician runs across a bad relay, what should he do?

   a. replace the relay.
   b. file the points in the relay.
   c. repair it if it doesn't cost over $5.00 to fix.
   d. send it away to be serviced.

6. When replacing a relay, you should always be careful to:

   a. calibrate the relay before installing.
   b. mark all wires carefully.
   c. make sure the relay is inverted before installing.
   d. check overload for power.

7. What is the most effective way to determine if the relay is causing trouble?

   a. use a jump test box.
   b. check the thermostat to see if it's working.
   c. check all other parts of the circuit.
   d. make sure the capacitor is closed.

8. How should a weight type amperage relay be mounted?

   a. horizontally
   b. in an inverted position.
   c. in a vertical position.
   d. it doesn't matter how it is mounted.

File Code: 751.02.07.03

Date Published: 11/29/77

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: MOTOR CONTROLS

INTRODUCTION:

This LAP covers the various motor controls used on typical refrigeration units. The prerequisite is to have read and completed the previous LAP successfully.

REVIEW:

There are several types of motor controls used on different refrigeration units. A good technician must understand the functions of all these controls to be able to service the equipment successfully.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain how the various controls function.
2. Check controls for proper operation.
3. Replace defective controls.

ASSIGNMENT:

Study Chapter 8 in Modern Refrigeration and Air Conditioning, covering motor control devices. Read experiment 11 in your lab manual.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

Go to the trainer and do experiment 11. Be careful when using the trainer. If you have any problems, notify your instructor.

Principal Author(s): John Carey

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. What a motor control does.
2. The different types used and how they operate.
3. How to troubleshoot controls.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ____________________ File Code: 751.02.07.03

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST: MOTORS

1. Electric motors used in refrigeration systems are classified as:

   a. split phase and open motors.
   b. capacitor start and hermetic motors.
   c. open motors and hermetic motors.
   d. split phase and capacitor start.

2. Motor uses may be grouped as follows: (Which one is not correct)

   a. to drive compressors.
   b. to drive fans.
   c. to drive pumps.
   d. to drive solenoids.

3. When taking a resistance check, on a motor winding, what do you use?

   a. a volt meter.
   b. an ohm meter.
   c. an amprobe.
   d. a capacitor analyzer.

4. To check the current pull of a motor, what piece of test equipment do you use?

   a. a volt meter.
   b. a capacitor analyzer.
   c. a relay overload checker.
   d. an amp meter.

5. What is used to protect the motor from excess starting current?

   a. bi-metal type overload.
   b. a fusetron.
   c. a cartridge fuse.
   d. resistance plug wire.

6. How many types of internal overload protectors are there?

   a. 5
   b. 3
   c. 1
   d. 2

7. In a hermetic split phase induction motor, what winding would have the most resistance?

   a. start winding.
   b. main winding.
   c. both the same.
   d. auxiliary winding.

8. If a compressor is not marked properly, can a service technician tell which terminal would be start, which one is common and which one is run by using an ohm meter?

   a. only on Westinghouse units.
   b. only on Whirpool units.
   c. no.
   d. yes, by the resistance of the winding.

9. How many methods are there of starting a stuck compressor?

   a. 1
   b. 2
   c. 3
   d. 4

10. What is used to check a hermetically sealed compressor?

   a. a compressor analyzer.
   b. a resistance meter.
   c. a capacitor analyzer.
   d. a thermo jump box.

File Code: 751.02.07.04

Date Published: 11/29/77

Mountain-Plains Education &
Economic Development
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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: DEFROST TIMERS

INTRODUCTION:

This LAP covers the various types of defrost timers used on refrigeration equipment. The prerequisite is to have read and completed successfully the previous LAP.

REVIEW:

Evaporator coils build up frost from the condensation that takes place. Various defrost timers are used to cycle the unit into defrost so the coils can be heated and defrosted.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain the purpose and cycle of a defrost timer.
2. Check timer for proper operation.
3. Charge a defective timer correctly.

ASSIGNMENT:

Study Chapter 8 in Modern Refrigeration and Air Conditioning, covering defrost timers.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

Have your instructor assign you a refrigerator. Remove the defrost timer and check it for proper operation. Inspect the defrost heaters and bi metal device. After disassembly, notify your instructor. When he gives you his approval, reassemble the unit. Be careful when working on these devices. Ask questions when you are not sure of something.

Principal Author(s): John Carey

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor check your work. All items must be accomplished successfully as assessed by your instructor.

SUMMARY:

Go over the test with your instructor. You should now understand the following:

1. How a defrost timer works.
2. How to check it.
3. How to replace one.

After successful completion, record LAP on SPR. Study for Unit Tests. When you feel you are ready, ask your instructor for the Unit Tests, Written and Performance.

Student: ______________________ File Code: 751.02.07.04

Date: ______________________ Date Published: 11/17/77

Family Education Program

LAP TEST: TIMERS

1. What is the purpose of a defrost timer?

   a. to remove ice build-up on the evaporator.
   b. to remove condensation on the condenser.
   c. to energize heaters in the evaporator.
   d. to release high ice pressure from the system.

2. On a heat pump, when the system goes into defrost, the defrost timer is energizing the heater for what unit?

   a. the evaporator coil.
   b. the condenser coil.
   c. the indoor coil.
   d. the outdoor coil.

3. If a defrost timer fails to function in a refrigerator, what will happen?

   a. the evaporator will ice up.
   b. the condenser will ice up.
   c. the drain line will freeze up.
   d. the evaporator fan will be overworked.

4. Besides cycling the defrost heater what else does the defrost timer do?

   a. it cycles the evaporator high limit switch.
   b. it cycles the evaporator low limit switch.
   c. it cycles the compressor.
   d. it will turn power off to the interior light of the refrigerator.

5. In a domestic refrigerator, how often does the system go into defrost on the majority of the models?

   a. every 36 hours.
   b. every 8 hours.
   c. every 16 hours.
   d. every 12 hours.

Student: ______________________ **File Code:** 751.02.07.00

Date: ______________________ **Date Published:** 2-20-78

Family
Education
Program

UNIT TEST: ELECTRIC CIRCUIT CONTROLS

75.02.07.01

1. Name two (2) types of motor cycling controls.

   a. thermostats and pressure switches.
   b. pressure switches and momentary overrides.
   c. thermostats and fuser contacts.
   d. capillary tubes switches and high frequency interference switches.

2. What is the most common type of thermostat?

   a. bi-metal strip.
   b. series would resistance strip.
   c. high pressure overload switch.
   d. low pressure relay overload control inductor switch.

3. What does a diaphragm low pressure switch use to sense the temperature?

   a. thermocouple.
   b. a sensing bulb.
   c. inductance tube.
   d. heat coil.

4. On a thermostat, what does a differential adjustment control screw do?

   a. it adjusts the humidity control.
   b. the temperature between cut-out and cut-in.
   c. the super-heat cut-in and cut-out.
   d. it adjusts the on time of the compressor.

5. What is the purpose of the altitude adjustment control?

   a. it affects the thermostat used in commercial airplanes that are carrying refrigeration equipment.
   b. it is only used in walk-in coolers.
   c. it is used to adjust the cold control to various altitudes.
   d. it anticipates altitude change.

75.02.07.02

6. How many types of starting relays are used in refrigeration?

   a. 2
   b. 3
   c. 4
   d. 6

75.02.07.03 (continued)

14. To check the current pull of a motor, what piece of test equipment do you use?

    a. a volt meter.
    b. a capacitor analyzer.
    c. a relay overload checker.
    d. an amp meter.

15. What is used to protect the motor from excess starting current?

    a. bi-metal type overload.
    b. a fusetron.
    c. a cartridge fuse.
    d. resistance plug wire.

16. How many types of internal overload protectors are there?

    a. 5
    b. 3
    c. 1
    d. 2

17. In a hermetic split phase induction motor, what winding would have the most resistance?

    a. start winding.
    b. main winding.
    c. both the same.
    d. auxiliary winding.

18. If a compressor is not marked properly, can a service technician tell which terminal would be start, which one is common, and which one is run by using an ohm meter?

    a. only on Westinghouse units.
    b. only on Whirlpool units.
    c. no.
    d. yes, by the resistance of the winding.

19. How many methods are there of starting a stuck compressor?

    a. 1
    b. 2
    c. 3
    d. 4

20. What is used to check a hermetically sealed compressor?

    a. compressor analyzer.
    b. a resistance meter.
    c. a capacitor analyzer.
    d. a thermo jump box.

75.02.07.04

21. What is the purpose of a defrost timer?

    a. to remove ice build-up on the evaporator.
    b. to remove condensation on the condenser.
    c. to energize heaters in the evaporator.
    d. to release high ice pressure from the system.

22. On a heat pump, when the system goes into defrost, the defrost timer is energizing the heater for what unit?

    a. the evaporator coil.
    b. the condenser coil.
    c. the indoor coil.
    d. the outdoor coil.

23. If a defrost timer fails to function in a refrigerator, what will happen?

    a. the evaporator will ice up.
    b. the condenser will ice up.
    c. the drain line will freeze up.
    d. the evaporator fan will be overworked.

24. Besides cycling the defrost heater, what else does the defrost timer do?

    a. it cycles the evaporator high limit switch.
    b. it cycles the evaporator low limit switch.
    c. it cycles the compressor.
    d. it will turn power off to the interior light of the refrigerator.

25. In a domestic refrigerator, how often does the system go into defrost on the majority of the models?

    a. every 36 hours.
    b. every 8 hours.
    c. every 16 hours.
    d. every 12 hours.

Student: ______________________ File Code: 751.02.07.00

Date: ______________________ Date Published: 1-27-78

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

UNIT PERFORMANCE TEST: ELECTRIC CIRCUIT CONTROLS

OBJECTIVE 1:

Using appropriate tools, equipment, supplies, and procedures, locate and correct troubles in a typical refrigerator or window air conditioner.

TASK:

Repair and service a domestic refrigerator or a window air conditioner, using appropriate tools, equipment, supplies, and procedures.

ASSIGNMENT:

CONDITIONS:

You will be allowed to use all the typical tools, equipment, supplies, and references commonly found in a typical refrigeration repair shop. You will not be allowed to receive any assistance from the instructor or other students.

RESOURCES:

Printed Material:
Modern Refrigeration and Air Conditioning, Althouse

Equipment:
A charged, but inoperative hermetic refrigerator
One window air conditioner.

ASSIGNMENT SHEET

OBJECTIVE 1: HERMETIC SYSTEM

1. Start the system. If the unit won't start:
   (a) Check the electrical circuit, wall receptacles, thermostat, relay, capacitor, and wiring.
   (b) If internal trouble is indicated, a shop overhaul or replacement is necessary.

2. If the unit starts but shuts off almost immediately, this trouble indicates an overload. The motor overload device is opening the circuit. Locate the trouble, repair if external or a major overhaul is necessary.

3. If the unit runs continuously with little or no refrigeration,
   (a) Check for a dirty condenser or poor air flow
   (b) Install gauge manifold to determine the low and high side operating pressures and to check for refrigerant charge, clogged screens, etc.

4. If the unit refrigerates, but not satisfactorily, check for moisture in system or lack of refrigerant.

5. If the unit over-refrigerates (too cold), check the motor control thermostat.

Name of Unit__________________________ Model_____________________ Year_______________

Kind of Refrigerant___________________ Amount of Refrig., Lbs.________ Oz.____________

Normal Head Pressure______________________ Normal Low Side Pressure___________________

Remarks:

ASSIGNMENT SHEET

OBJECTIVE 1: WINDOW TYPE COMFORT COOLER

1. Test the external circuit first: Power in, thermostat, relay, capacitors, overload protectors, motor compressor, filters, air flow, etc.
2. Install gauges and test for leaks.
3. Run the unit for at least fifteen minutes.
4. If the unit is frosting or sweating down the suction line, the system may be overcharged.
5. If the coil is starved, the screen or drier is partially clogged with moisture or dirt or the unit is undercharged.
6. Repair what is necessary. Remove the refrigerant. BE CAREFUL! Replace the worn part. Assemble the unit. Evacuate the air, charge, and test for leaks.

	At the Beginning	After 15 Minutes	After Repair
Low Side Pressure			
High Side Pressure			
Suction Line Temp., Approx.			
Liquid Line Temp., Approx.			
Evaporator Air Temperature			
Noise: Compressor			
Motor			

Remarks:

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

Student: ____________________ File Code: 751.02.07.00

Date: ____________________ Date Published: ____________________

Family Pay Number: ____________ Sex: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory_____ Unsatisfactory_____

	CRITERION Met	 Not Met
Objective 1:		
1. Uses appropriate safety procedures.		
Criterion: No injury results to anyone and procedures used compare to OSHA requirements.		
2. Uses appropriate tools and equipment, and supplies.		
Criterion: Modern Refrigeration and Air Conditioning, paragraphs 8-36, 12-1 through 12-23, 3-22, 9-19 through 9-22, 15-99, 21-5, 21-7, and manufacturer's specifications and directions.		
3. Uses appropriate troubleshooting procedures.		
Criterion: Locates the malfunction without assistance from other people.		
4. Uses appropriate repair procedures.		
Criterion: Modern Refrigeration and Air Conditioning, and Manufacturer's specifications and directions.		
5. Work is neat and professional.		

_____(Checklist continued)

	CRITERION	
	Met	Not Met
Criterion: *Modern Refrigeration and Air Conditioning*, and Manufacturer's specifications and directions.		
6. Gauge manifold is properly installed.		
Criterion: *Modern Refrigeration and Air Conditioning*, 12-17.		
7. Data requested on the job sheet is accurate and complete.		
Criterion: Compares to manufacturer's specifications.		
8. System has no leaks		
Criterion: No leaks can be detected by the instructor.		
9. All electrical and mechanical connections and fastenings are appropriate.		
Criterion: Mechanical installations compare to the manufacturer's specifications and electrical connections are correct according to the NEC (National Electrical Code.)		
10. System is operational.		
Criterion: It functions according to the manufacturer's specifications		
11. The job is completed in a reasonable time.		
Criterion: Not to exceed 6 hours.		
The student cannot miss line items 10 or 11. Otherwise, he must satisfactorily complete 7 out of 9 items to pass this test.		

LAP TEST ANSWER KEY: STARTING RELAYS AND OVERLOADS

1. b
2. d
3. c
4. d
5. a
6. b
7. c
8. c

LAP TEST ANSWER KEY: MOTOR CONTROLS

1. c
2. d
3. b
4. d
5. a
6. d
7. a
8. d
9. c
10. a

LAP TEST ANSWER KEY: DEFROST TIMERS

1. c
2. d
3. a
4. c
5. d

UNIT TEST ANSWER KEY: ELECTRIC CIRCUIT CONTROLS

LAP 01

1. A
2. A
3. B
4. [illegible] B
5. C

LAP 02

6. [illegible] C
7. D
8. C
9. A
10. C

LAP 03

11. C
12. D
13. B
14. D
15. A
16. D
17. A
18. D
19. C
20. A

LAP 04

21. C
22. [illegible] A
23. A
24. C
25. D

File Code: 751.02.08.01

Date Published: 11/10/77

Family Education Program

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: DOMESTIC REFRIGERATION

INTRODUCTION:

This LAP covers the typical domestic refrigerators used today. The only prerequisite is to have read and completed successfully the previous units.

REVIEW:

In today's modern world, nearly everyone has at least one refrigerator in his home. Sometime or another they do malfunction and need some type of service. Depending on the type of refrigeration shop you are in, you may be working a great deal of the time on domestic refrigerators.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain the operation of a typical refrigerator.
2. Troubleshoot a refrigerator.
3. Make necessary repairs and determine that it operates correctly.

ASSIGNMENT:

Study Chapter 11 in Modern Refrigeration and Air Conditioning, covering domestic refrigerators.

WRITTEN EVALUATION:

When you have completed the assignment, take the written test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

Have your instructor assign a refrigerator to you to repair. Using information you have learned so far, systematically check the unit for proper operation. If you run into a problem, ask your instructor for help.

Principal Author(s): John Carey

Family Training Center, Inc.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Have your instructor review your test. You should now understand the following:

1. How a domestic refrigerator functions.
2. How to troubleshoot a system.
3. How to repair malfunctions.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ____________________ File Code: 751.02.08.01

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST: REFRIGERATORS

1. What extra part is used on a force convection type that isn't used on a static condenser?

   a. low pressure switch.
   b. high pressure switch.
   c. static switch.
   d. condensor fan motor.

2. In most domestic refrigerators, what are the evaporators made out of?

   a. aluminum and stainless steel.
   b. aluminum and copper.
   c. copper and stainless steel.
   d. copper and chrome plated brass.

3. In a force convection evaporator, how is the air moved to the refrigerator area?

   a. through natural convection.
   b. by the use of a fan.
   c. by gravity.
   d. with an exhaust blower.

4. What is one major achievement that helped the refrigeration industry?

   a. the hermetically sealed compressor.
   b. the teflon seal.
   c. the invention of freon.
   d. the invention of the rotary compressor.

5. How are most joints on domestic refrigerators connected?

   a. they are flared.
   b. they are epoxied.
   c. they are silver soldered.
   d. they are welded.

Family Education Program

File Code: 751.02.08.02

Date Published: 11/10/77

Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: AIR CONDITIONER

INTRODUCTION:

This LAP covers home air conditioners. The only prerequisite is to have read and completed successfully the previous LAP.

REVIEW:

In today's modern world more and more people are looking for total comfort in their homes. Millions of people are air conditioning their homes to make them more liveable in the hot summer months. These units need some kind of maintenance and repair work to keep them functioning properly.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain how a typical air conditioner operates.
2. Troubleshoot the system.
3. Correctly repair the unit.

ASSIGNMENT:

Study Chapter 19 through 21 in Modern Refrigeration and Air Conditioning, covering the fundamentals of cooling and dehumidifying.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

Have your instructor assign a window air conditioner for you to work on. Disassemble the unit, go over it with your instructor and then reassemble it. Be careful when working with the unit, ask questions when you run into a problem you can't handle.

Principal Author(s): John Carey

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your Performance Test. All items must be accomplished successfully as assessed by your instructor.

SUMMARY:

Have your instructor go over the test with you. You should now understand the following:

1. How an air conditioner operates.
2. How to troubleshoot a unit.
3. How to make any necessary repairs.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ____________________ **File Code:** 751.02.08.02

Date: ____________________ **Date Published:** 11/17/77

Family
Education
Program

LAP TEST: AIR CONDITIONERS

1. What are the 2 basic types of air conditioning systems used in homes?

   a. self-contained and remote.
   b. water cooled and sealed systems.
   c. remote and window units.
   d. window units and self-contained.

2. What is the approximate evaporator temperature in degrees Fahrenheit of a window air conditioner?

   a. 35 - 40
   b. 40 - 45
   c. 50 - 55
   d. 40 - 50

3. What is one of the most important parts of an air conditioner?

   a. high pressure release valve.
   b. wiring diagram.
   c. thermostat knob.
   d. the ice control.

4. How do you install a window air conditioner?

   a. level in a safe location.
   b. anywhere that it will fit.
   c. level with easy access.
   d. according to manufacturer's recommended specifications.

5. In a split system central air conditioner unit, where does the evaporator sit?

   a. on a firm foundation on the oustide of the house.
   b. level in the plenum.
   c. in the return air of the heating system.
   d. 1¼" off the heat exchanger.

6. Where is the BTU rating of an air conditioner found?

   a. right next to the compressor suction line.
   b. on the parts list.
   c. on the name plate stamped on the unit.
   d. stamped on the condenser inlet.

7. What does an air conditioner remove besides heat?

   a. condensation.
   b. odors.
   c. smoke.
   d. dust particles from the air.

File Code: 751.02.08.03

Date Published: 11/10/77

Family Education Program

Learning Activity Package

Student: __________

Date: __________

PERFORMANCE ACTIVITY: FREEZERS

INTRODUCTION:

This LAP covers the typical domestic freezer used in the average home today. The only prerequisite is to have read and completed the previous LAP successfully.

REVIEW:

With today's food prices rising, many home owners are buying food on sale and freezing it. This has stimulated the freezer industry. Thousands of new units are sold yearly. These units need maintenance and repairs at some time or another.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain how the typical freezer operates.
2. Be able to troubleshoot the system.
3. Make repairs according to manufacturer's recommended specifications.

ASSIGNMENT:

Study Chapter 10 and 11 in Modern Refrigeration and Air Conditioning, covering domestic freezers and hermetic systems.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

None.

Principal Author(s): John Carey

PERFORMANCE EVALUATION:

Check with your instructor about taking a Performance Test.

REVIEW:

Have your instructor go over the LAP test with you. You should now understand the following:

1. How a freezer operates.
2. How to troubleshoot the unit.
3. How to make the necessary repairs.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ____________________ File Code: 751.02.08.03

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST: FREEZERS

1. On a manual defrost freezer, why does ice form on the top shelf first?

   a. hot air rises, cold air falls.
   b. cold air rises, hot air falls.
   c. forms on the bottom first.
   d. it is the bottom shelf.

2. Name three common designs of evaporator coils used in frozen food freezers?

   a. shell liner, plate or force convection.
   b. force convection. interior liner and shell liner.
   c. plate, force convection and elongated.
   d. elongated, force convection and shell liner.

3. When defrosting a freezer, what must you be careful of?

   a. long periods where the freezer may stand idle.
   b. overheating the evaporator coil with hot water.
   c. not to leave the door shut, because odor and bacteria will form.
   d. poking the evaporator with sharp objects.

4. What type of freezer loses the most cold air when the door is open?

   a. upright.
   b. chest.
   c. combination.
   d. side by side.

5. When a chest freezer is operating, what will the exterior wall feel?

   a. cold.
   b. warm.
   c. the same temperature as the room.
   d. very hot at the bottom.

6. What causes freezer burn?

   a. increase moisture.
   b. loss of moisture.
   c. not cold enough temperature.
   d. too cold of temperature.

File Code: 751.02.08.04

Date Published: 11/16/77

Family
Education
Program

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: HEAT PUMP

INTRODUCTION:

This LAP covers heat pumps used in typical home installation. The prerequisite is to have read and completed successfully the previous LAPS.

REVIEW:

With the rising cost of electricity and the restrictions on new gas hook ups, heat pumps have made a strong comeback in the heating cooling market. The new pumps are more efficient and reliable than previous pumps. They can also save more on electric bills than strip heat in most cases.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain how a heat pump operates.
2. Troubleshoot systems electric and mechanical.
3. Replace all defective components.
4. Explain how to figure heat gain and loss charts.
5. Properly use appropriate test equipment.

ASSIGNMENT:

Read Chapter 26 in Modern Refrigeration and Air Conditioning, covering heat pumps. Read over experiment 9 in your lab manual.

WRITTEN EVALUATION:

When you have completed the assignment, take the test.

DEMONSTRATION:

Have your instructor demonstrate the use of the heat pump. If you have any questions on the operation of the heat pump, ask before proceeding further.

Principal Author(s): John Carey

PERFORMANCE:

When you feel you understand the operation, go to the heat pump and run it through a heating and cooling cycle. If at any time you have a problem, notify the instructor. Once you are through with that, start the disassembly of the unit, removing the following:

CAUTION: MAKE SURE POWER IS OFF, CHECK WITH METER.

OUTSIDE UNIT

1. cover
2. fan motor
3. capacitor

Check the wiring of all electrical parts removed.

INSIDE UNIT

1. cover
2. fan motor
3. strip heater
4. capacitor
5. overload

Notify the instructor when you have disassembled the unit, with his permission resassemble it. Your instructor must check over your assembly of the heat pump. When it is together according to manufacturer's specifications, cycle the unit in heating and cooling. Have your instructor go over heat gain and loss chart with you.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor check your Performance Test. All items must be accomplished successfully as assessed by your instructor.

SUMMARY:

Have your instructor go over the test with you. You should now understand the following:

1. How a heat pump operates.
2. Proper installation is needed to give trouble-free, efficient service.
3. How to figure a heat gain and loss chart.
4. The procedure for troubleshooting and repair.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ File Code: 751.02.08.04

Date: ______________________ Date Published: 11/17/77

Family Education Program

LAP TEST: HEAT PUMP

1. What is the purpose of a heat pump?

   a. transfer refrigerant.
   b. transfer heat.
   c. remove cold air.
   d. clean the air.

2. What are heat pumps rated in?

   a. B.T.U.
   b. pounds per square inch.
   c. tons.
   d. pounds.

3. Where is the 4-way valve located?

   a. in the indoor unit.
   b. in the outdoor unit.
   c. above the evaporator coil.
   d. it's incorporated in the thermostat.

4. When there is no power to the 4-way valve, in what mode is the valve?

   a. heating mode.
   b. cooling mode.
   c. cleaning mode.
   d. in neither heating or cooling.

5. What is another name for a 4-way valve?

   a. reversing valve.
   b. heat transfer valve.
   c. switching valve.
   d. inverting valve.

6. How many BTU's of heat are there in one kilowatt?

   a. 3,000 BTU.
   b. 2,800 BTU.
   c. 3,300 BTU.
   d. 3,412 BTU.

7. What is the difference in suction and liquid line of a heat pump compared to central air?

   a. they are generally smaller.
   b. they are about the same.
   c. they are generally larger.
   d. there is no difference.

8. When replacing the 4-way valve, what is the most important thing to remember?

   a. to use good epoxy.
   b. to clean all joints using a round file.
   c. make sure the 3 ports are to the top.
   d. use a heat sink to prevent damage to the valve.

9. What is used to back up the heat pump in extreme cold weather?

   a. gas heating system.
   b. strip resistance heat.
   c. oil fired heating system.
   d. solar power.

10. What defrosts the outdoor unit while in the heating mode?

    a. hot gas.
    b. electric element.
    c. combination of hot gas and electric element.
    d. warm air from the furnace.

11. What is placed on the compressor to prevent migration of refrigerant?

    a. a high sight pressure switch.
    b. a low sight pressure switch.
    c. a crankcase heater.
    d. combination induction heater.

12. What is placed on the suction line to prevent slugging of the compressor?

    a. liquid receiver.
    b. acumulator.
    c. pressure invertor valve.
    d. suction trap.

13. What are used in the sealed system to prevent the refrigerant from going in the wrong direction?

    a. manifold check valve.
    b. high pressure release valve.
    c. anti-reverse valve.
    d. 4-way valve.

14. How many thermostat expansion valves are used in the heat pump?

    a. 4
    b. 3
    c. 2
    d. none

15. Are capillary tubes used on heat pumps?

    a. yes.
    b. no.
    c. only on Westinghouse.
    d. only on General Electric units.

File Code: 751.02.08.05

Date Published: 11/16/77

Family Education Program

Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: DEHUMIDIFIER

INTRODUCTION:

This LAP covers a typical dehumidifier used in the average home. The prerequisite is to have read and completed the previous LAPS.

REVIEW:

In several areas of the country, high humidity causes great discomfort during the summer months. There is a great demand for dehumidifiers used to lower the humidity, making the area more liveable.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain how a dehumidifier works.
2. Repair it.

ASSIGNMENT:

Study Chapter 21 in Modern Refrigeration and Air Conditioning, covering dehumidifying.

WRITTEN EVALUATION:

When you have completed the assignment, take the test.

DEMONSTRATION:

None.

PERFORMANCE:

None.

PERFORMANCE EVALUATION:

There is no Performance Test. All items must be accomplished successfully as assessed by your instructor.

Principal Author(s): John Carey

Family Training Center, Inc.

SUMMARY:

Have your instructor go over your test. You should now understand the following:

1. How a dehumidifier works.
2. Procedure for repairing.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ____________________ **File Code:** 751.02.08.05

Date: ____________________ **Date Published:** 11/17/77

Family Education Program

LAP TEST: DEHUMIDIFIERS

1. What is the purpose of a dehumidifier?

   a. remove moisture from the air.
   b. remove heat from the area.
   c. clean the air.
   d. take unwanted odors from the air.

2. What cycles the humidifier?

   a. temperature control.
   b. humidistat.
   c. moisture control.
   d. inverted safety switch.

3. In a humidifier, where does the moisture condense?

   a. on a condenser coil.
   b. on the evaporator.
   c. in the compressor.
   d. on the condenser plates.

4. Where is a good place to locate a dehumidifier?

   a. in the attic.
   b. in the basement.
   c. upstairs.
   d. on the porch.

5. What is a dehumidifier made up of?

   a. basically like a heat pump.
   b. small hermetic refrigeration system.
   c. similar to a freezer.
   d. operates like a car air conditioner.

6. Where does the condensation go in a dehumidifier?

   a. in a collecting container.
   b. it's evaporated.
   c. it's piped into the drain.
   d. there is no condensation.

Student: ____________________ File Code: 75.02.08.06

Date: ____________________ Date Published: 11/17/77

Family Education Program

LAP TEST: CAR AIR CONDITIONER

1. Where is the condenser usually mounted?

   a. behind the radiator.
   b. in front of the evaporator.
   c. in front of the radiator.
   d. along side the compressor.

2. What is the most popular type of refrigerant used in auto air conditioning?

   a. refrigerant 22.
   b. refrigerant 502.
   c. refrigerant 11.
   d. refrigerant 12.

3. How does a serviceman determine if the system is low on refrigerant?

   a. check sight glass.
   b. check amp reading.
   c. check voltage reading.
   d. check combined pressure of high side and low side.

4. What engages the compressor?

   a. the thermostat.
   b. electromagnetic clutch.
   c. power clutch.
   d. pnuematic clutch.

5. What usually causes the majority of leaks in the car air conditioner?

   a. poor joints.
   b. leaky evaporator.
   c. leaky condenser.
   d. compressor seal wearing out.

6. What type of compressor uses the swash buckle design?

   a. Frigidaire.
   b. Chrysler.
   c. York.
   d. Ford.

7. What side do you charge a car air conditioner when running?

   a. the high side.
   b. on either side.
   c. the low side.
   d. both sides at the same time.

8. Where is the dryer located in a car air conditioner?

   a. with the compressor.
   b. in the receiver.
   c. at the beginning of the condenser.
   d. at the end of the evaporator.

9. How many inches of vacuum should a good compressor pump?

   a. 12
   b. 14
   c. 11
   d. 15

10. When working with refrigerant, a service technician should always:

    a. be careful not to invert the can.
    b. wear goggles.
    c. wear gloves.
    d. work in a well lighted area.

Student: ______________________ **File Code:** 751.02.08.00

Date: ______________________ **Date Published:** 2-20-78

Family Education Program

UNIT TEST: DOMESTIC EQUIPMENT

75.02.08.01

1. What extra part is used on a force convection type that isn't used on a static condenser?

    a. low pressure switch.
    b. high pressure switch.
    c. static switch.
    d. condensor fan motor.

2. In most domestic refrigerators, what are the evaporators made out of?

    a. aluminum and stainless steel.
    b. aluminum and copper.
    c. copper and stainless steel.
    d. copper and chrome plated brass.

3. In a force convection evaporator, how is the air moved to the refrigerator area?

    a. through natural convection.
    b. by the use of a fan.
    c. by gravity.
    d. with an exhaust blower.

4. What is one major achievement that helped the refrigeration industry?

    a. the hermetically sealed compressor.
    b. the teflon seal.
    c. the invention of freon.
    d. the invention of the rotary compressor.

5. How are most joints on domestic refrigerators connected?

    a. they are flared.
    b. they are epoxied.
    c. they are silver soldered.
    d. they are welded.

75.02.08.02

6. What are the two basic types of air conditioning systems used in homes?

    a. self-contained and remote.
    b. water cooled and sealed systems.
    c. remote and window units.
    d. window units and self-contained.

75.02.08.02 (continued)

7. What is the approximate evaporator temperature in degrees Fahrenheit of a window air conditioner?

   a. 34 - 40
   b. 40 - 45
   c. 50 - 55
   d. 40 - 50

8. What is one of the most important parts of an air conditioner?

   a. high pressure release valve.
   b. wiring diagram.
   c. thermostat knob.
   d. the ice control.

9. Where is the BTU rating of an air conditioner found?

   a. right next to the compressor suction line.
   b. on the parts list.
   c. on the name plate stamped on the unit.
   d. stamped on the condenser inlet.

10. What does an air conditioner remove besides heat?

   a. condensation.
   b. odors.
   c. smoke.
   d. dust particles from the air.

75.02.08.03

11. On a manual defrost freezer, why does ice form on the top shelf first?

   a. hot air rises, cold air falls.
   b. cold air rises, hot air falls.
   c. forms on the bottom first.
   d. because the instructor said so.

12. Name three common designs of evaporator coils used in frozen food freezers.

   a. shell iner, plate or force convection.
   b. force convection, interior liner and shell liner.
   c. plate, force convection and elongated.
   d. elongated, force convection and shell liner.

13. When defrosting a freezer, what must you be careful of?

   a. long periods where the freezer may stand idle.
   b. overheating the evaporator coil with hot water.
   c. not to leave the door shut, because odor and bacteria will form.
   d. poling the evaporator with sharp objects.

75.02.08.03 (continued)

14. When a chest freezer is operating, will the exterior wall feel:

    a. cold.
    b. warm.
    c. the same temperature as the room.
    d. very hot at the bottom.

15. What causes freezer burn?

    a. increase moisture.
    b. loss of moisture.
    c. not cold enough temperature.
    d. too cold of temperature.

75.02.08.04

16. What is the purpose of a heat pump?

    a. transfer refrigerant.
    b. transfer heat.
    c. remove cold air.
    d. clean the air.

17. What are heat pumps rated in?

    a. B.T.U.
    b. pounds per square inch.
    c. tons.
    d. pounds.

18. When there is no power to the 4-way valve, in what mode is the valve?

    a. heating mode.
    b. cooling mode.
    c. cleaning mode.
    d. in neither heating or cooling.

19. What is another name for a four-way valve?

    a. reversing valve.
    b. heat transfer valve.
    c. switching valve.
    d. inverting valve.

20. What is the difference in suction and liquid line of a heat pump compared to central air?

    a. they are generally smaller.
    b. they are about the same.
    c. they are generally larger.
    d. there is no difference.

75.02.08.05 (continued)

28. Where is a good placd to locate a dehumidifier?

   a. in the attic.
   b. in the basement.
   c. upstairs.
   d. on the porch.

29. What is a dehumidifier made up of?

   a. basically like a heat pump.
   b. small hermetic refrigeration system.
   c. similar to a freezer.
   d. operates like a car air conditioner.

30. Where does the condensation go in a dehumidifier?

   a. in a collecting container.
   b. it's evaporated.
   c. it's piped into the drain.
   d. there is no condensation.

75.02.08.06

31. Where is the condenser usually mounted?

   a. behind the radiator.
   b. in front of the evaporator.
   c. in front of the radiator.
   d. along side the compressor.

32. What is the most popular type of refrigerant used in auto air conditioning?

   a. refrigerant 22
   b. refrigerant 502.
   c. refrigerant 11.
   d. refrigerant 12.

33. How does a serviceman determine if the system is low on refrigerant?

   a. check sight glass.
   b. check amp reading.
   c. check voltage reading.
   d. check combined pressure of high side and low side.

34. What engages the compressor?

   a. the thermostat.
   b. electromagnetic clutch.
   c. power clutch.
   d. pnuematic clutch.

75.02.08.06 (continued)

35. What usually causes the majority of leaks in the car air conditioner?

a. poor joints.
b. leaky evaporator.
c. leaky condenser.
d. compressor seal wearing out.

36. What type of compressor uses the swash buckle design?

a. Frigidaire.
b. Chrysler.
c. York.
d. Ford.

37. What side do you charge a car air conditioner when running?

a. the high side.
b. on either side.
c. the low side.
d. both sides at the same time.

38. Where is the dryer located in a car air conditioner?

a. with the compressor.
b. in the receiver.
c. at the beginning of the condenser.
d. at the end of the evaporator.

39. How many inches of vacuum should a good compressor pump?

a. 12
b. 14
c. 11
d. 15

40. When working with refrigerant, a service technician should always:

a. be careful not to invert the can.
b. wear goggles.
c. wear gloves.
d. work in a well lighted area.

Student: ____________________ File Code: 751.02.08.00

Date: ____________________ Date Published: 1-27-78

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

UNIT PERFORMANCE TEST: DOMESTIC EQUIPMENT

OBJECTIVE 1:

Using appropriate tools, equipment, supplies, and procedures, locate and correct troubles in a typical refrigerator or window air conditioner.

TASK:

Repair and service a domestic refrigerator or a window air conditioner, using appropriate tools, equipment, supplies, and procedures.

ASSIGNMENT:

CONDITIONS:

You will be allowed to use all the typical tools, equipment, supplies, and references commonly found in a typical refrigeration repair shop. You will not be allowed to receive any assistance from the instructor or other students.

RESOURCES:

Printed Material:
Modern Refrigeration and Air Conditioning, Althouse

Equipment:
A charged, but inoperative hermetic refrigerator
One window air conditioner.

RESOURCES (Cont.):

Tools:
1 Hermetic service valve attachment kit
1 8 inch adj. open wrench
1 4 inch screwdriver - 1/4" x 1/32" blade
1 1/4" ratchet wrench
1 Set open end wrenches
1 6" screwdriver - 1/4" blade
1 #2 Phillips screwdriver
1 Pair safety goggles
1 Oiler with SAE 30

Instruments:
1 Hermetic analyzer or test light
1 Thermometer
1 Gauge manifold with refrigerant lines
1 Vacuum pump
1 Electrical analyzer

Supplies:
1 12" length of 1/8" dia. 50-50 solder
1 Clamp-on service valve
1 Can soldering flux
1 Wiping cloth

ASSIGNMENT SHEET

OBJECTIVE 1: HERMETIC SYSTEM

1. Start the system. If the unit won't start:
   (a) Check the electrical circuit, wall receptacles, thermostat, relay, capacitor, and wiring.
   (b) If internal trouble is indicated, a shop overhaul or replacement is necessary.

2. If the unit starts but shuts off almost immediately, this trouble indicates an overload. The motor overload device is opening the circuit. Locate the trouble, repair if external or a major overhaul is necessary.

3. If the unit runs continuously with little or no refrigeration,
   (a) Check for a dirty condenser or poor air flow
   (b) Install gauge manifold to determine the low and high side operating pressures and to check for refrigerant charge, clogged screens, etc.

4. If the unit refrigerates, but not satisfactorily, check for moisture in system or lack of refrigerant.

5. If the unit over-refrigerates (too cold), check the motor control thermostat.

Name of Unit____________________ Model__________________ Year____________

Kind of Refrigerant________________ Amount of Refrig., Lbs._______ Oz.________

Normal Head Pressure__________________ Normal Low Side Pressure________________

Remarks:

ASSIGNMENT SHEET

OBJECTIVE 1: WINDOW TYPE COMFORT COOLER

1. Test the external circuit first: Power in, thermostat, relay, capacitors, overload protectors, motor compressor, filters, air flow, etc.

2. Install gauges and test for leaks.

3. Run the unit for at least fifteen minutes.

4. If the unit is frosting or sweating down the suction line, the system may be overcharged.

5. If the coil is starved, the screen or drier is partially clogged with moisture or dirt or the unit is undercharged.

6. Repair what is necessary. Remove the refrigerant. BE CAREFUL! Replace the worn part. Assemble the unit. Evacuate the air, charge, and test for leaks.

	At the Beginning	After 15 Minutes	After Repair
Low Side Pressure			
High Side Pressure			
Suction Line Temp., Approx.			
Liquid Line Temp., Approx.			
Evaporator Air Temperature			
Noise: Compressor			
Motor			

Remarks:

Student: ____________________ **File Code:** 751.02.08.00

Date: ____________________ **Date Published:** ____________________

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

Family Pay Number:____________ Sex: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory_____ Unsatisfactory_____

	CRITERION	
	Met	Not Met
Objective 1:		
1. Uses appropriate safety procedures.		
Criterion: No injury results to anyone and procedures used compare to OSHA requirements.		
2. Uses appropriate tools and equipment, and supplies.		
Criterion: Modern Refrigeration and Air Conditioning, paragraphs 8-36, 12-1 through 12-23, 3-22, 9-19 through 9-22, 15-99, 21-5, 21-7, and manufacturer's specifications and directions.		
3. Uses appropriate troubleshooting procedures.		
Criterion: Locates the malfunction without assistance from other people.		
4. Uses appropriate repair procedures.		
Criterion: Modern Refrigeration and Air Conditioning, and Manufacturer's specifications and directions.		
5. Work is neat and professional.		

(Checklist continued)

	CRITERION	
	Met	Not Met
Criterion: Modern Refrigeration and Air Conditioning, and		
Manufacturer's specifications and directions.		
6. Gauge manifold is properly installed.		
Criterion: Modern Refrigeration and Air Conditioning, 12-17.		
7. Data requested on the job sheet is accurate and complete.		
Criterion: Compares to manufacturer's specifications.		
8. System has no leaks		
Criterion: No leaks can be detected by the instructor.		
9. All electrical and mechanical connections and		
fastenings are appropriate.		
Criterion: Mechanical installations compare to the manufacturer's specifications		
and electrical connections are correct according to the NEC		
(National Electrical Code.)		
10. System is operational.		
Criterion: It functions according to the manufacturer's specifications		
11. The job is completed in a reasonable time.		
Criterion: Not to exceed 6 hours.		
The student cannot miss line items 10 or 11. Otherwise, he		
must satisfactorily complete 7 out of 9 items to pass this test.		

LAP TEST ANSWER KEY: DOMESTIC REFRIGERATION

1. d
2. a
3. b
4. a
5. c

LAP TEST ANSWER KEY: AIR CONDITIONER

1. b
2. d
3. b
4. d
5. b
6. c
7. a

LAP TEST ANSWER KEY: FREEZER

1. a
2. a
3. d
4. a
5. b
6. b

LAP TEST ANSWER KEY: HEAT PUMP

1. b
2. c
3. b
4. b
5. a
6. d
7. c
8. d
9. b
10. a
11. c
12. b
13. a
14. c
15. a

LAP TEST ANSWER KEY: HUMIDIFIER

1. a
2. b
3. b
4. b
5. b
6. a

LAP TEST ANSWER KEY: AUTO

1. c
2. d
3. a
4. b
5. d
6. a
7. c
8. b
9. d
10. b

UNIT TEST ANSWER KEY: DOMESTIC EQUIPMENT

LAP 01

1. D
2. A
3. B
4. A
5. C

LAP 02

6. [illegible] A
7. D
8. B
9. C
10. A

LAP 03

11. A
12. A
13. D
14. B
15. B

LAP 04

16. B
17. C
18. B
19. A
20. C
21. D
22. [illegible] C
23. B
24. A
25. C

LAP 05

26. A
27. B
28. B
29. B
30. A

LAP 06

31. C
32. D
33. A
34. B
35. D
36. A
37. C
38. B
39. D
40. B

File Code: 751.02.09.01

Date Published: 11/10/77

Family Education Program

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: WALK IN COOLERS

INTRODUCTION:

This LAP covers walk in coolers used in commercial applications. The prerequisite is to have read and completed successfully the previous units.

REVIEW:

Walk in coolers are used in several applications. They can be used for beer coolers, for frozen food storage, at florist shops, various restaurants, grocery stores, hospitals and many other places. When a unit goes down, there is usually a large cost factor of goods that might be ruined. Fast, reliable service is needed as soon as possible.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Replace the following components:
    a. compressor
    b. condenser
    c. defrost timer
    d. heater
    e. TXV
    f. accumulator
    g. receiver
    h. fan motors
    i. filters
    j. sight glass
    k. pressure control
    l. solenoids
2. Check system for leaks.
3. Give voltage and amperage checks.
4. Change oil in units.

ASSIGNMENT:

Study Chapters 13, 14 and 15 in Modern Refrigeration and Air Conditioning, covering walk in cooler and components operation and service procedures. Go over experiment 15 in your lab manual.

Principal Author(s): John Carey

Family Training Center, Inc.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

Have your instructor explain the operations of the commercial trainer. Perform experiment 15 in your lab manual. Be careful when using the trainer, if you have any problems, notify your instructor.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Have your instructor go over your test with you. You should now understand the following:

1. How a walk in cooler operates.
2. What major components are used and how they work.
3. How to troubleshoot the system.
4. How to make necessary repairs.

After successful completion of this LAP, record it on SPR and proceed to the next LAP.

Student: ____________________ File Code: 751.02.09.01

Date: ____________________ Date Published: 12-13-77

Family Education Program

LAP TEST: WALK-IN COOLERS

1. Where is the evaporator located in a walk-in cooler?

   a. On top of the unit
   b. Along side the unit
   c. Inside the walk-in cooler
   d. Under the walk-in cooler

2. What cycles the compressor and determines the temperature of the walk-in cooler?

   a. Low pressure switch
   b. Ambian switch
   c. Lower reactor switch
   d. Upper reactor switch

3. When a service valve is screwed all the way in, will refrigerant flow through the system?

   a. No
   b. Yes
   c. Only on a Frigidaire system
   d. Depends on what refrigerant being used

4. In which position should the valve be turned when obtaining access to the service port?

   a. All the way in
   b. All the way out
   c. It doesn't matter
   d. 3/4 of a turn in

5. What should be installed on a liquid line on a walk-in cooler to check refrigerant level and if any moisture is present?

   a. Refrigerant level switch
   b. High pressure refrigerant switch
   c. A sight glass moisture indicator
   d. Moisture indicator and refrigerant level switch

6. What is used to absorb moisture and any foreign particles in a refrigeration system?

   a. An accumulator
   b. A receiver
   c. The evaporator
   d. A filter dryer

7. In a double evaporaotr system, what is used to control the amount of refrigerant flowing into the evaporator?

   a. Thermostat expansion valve
   b. Suction release valve
   c. High side release valve
   d. A suction metering valve

8. How are most condensers cooled?

   a. Forces air and water
   b. Water and oil
   c. Oil and forced air
   d. Oil and refrigerant cooled

9. What controls the amount of water flowing through a water cooled condenser?

   a. Water pressure switch
   b. Globe valve
   c. Gate valve
   d. Water operated low pressure solenoid valve

10. When charging a commercial system, with the unit running, you charge through:

    a. The high side
    b. Both the high and low side
    c. The low side
    d. Trhough the compressor release valve

11. What do you check for current draw on a system?

    a. Voltmeter
    b. Amp meter
    c. Capacitor analyzer
    d. Resistance meter

12. What do you use to check for acid content in a sealed system?

    a. Acid test kit
    b. Pressure drop across the filter
    c. Acid analyzer
    d. Paint discoloration in sight glass

13. In most systems what does the thermostat cycle?

    a. The compressor
    b. Solenoid
    c. Defrost timer
    d. The high pressure switch

Family
Education
Program

File Code: 751.02.09.02

Date Published: 11/10/77

Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: DISPLAY CASE

INTRODUCTION:

This LAP covers typical display cases used in various commercial applications. The prerequisite is to have read and completed the previous LAP.

REVIEW:

There are many different types of display cases used, each has its advantages and disadvantages. Most of the units use the same components, they may be mounted in different places but serve the same purpose. They all need maintenance and repair work at one time or another.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain how the system works.
2. Troubleshoot the system using appropriate test equipment.
3. Change defective components.

ASSIGNMENT:

Study Chapters 13, 14 and 15 in Modern Refrigeration and Air Conditioning, covering display cases, components and servicing. Review experiment 17 in your lab manual.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

Perform experiment 13 in the lab manual on the trainer. Be careful when using the trainer, if you have any problems, see your instructor for help.

Principal Author(s): John Carey

Family Training Center, Inc.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your Performance Test. All items must be accomplished successfully.

SUMMARY:

Have your instructor go over your test with you. You should now understand the following:

1. How a display case operates.
2. What components are used and how they work.
3. How to troubleshoot the system.
4. How to make repairs.

After successful completion of this LAP, record it on SPR and proceed to the next LAP.

Student: ______________________ File Code: 751.02.09.02

Date: ______________________ Date Published: 12-13-77

Family Education Program

LAP TEST: DISPLAY CASE

1. On a self-contained display case, where is the compressor located?

   a. In an adjoining room
   b. In the basement below the unit
   c. In the display case underneath
   d. In the evaporator compartment

2. What is used to prevent vibration of the lines in a refrigeration system?

   a. Flexible tubing
   b. Lines mounted on springs
   c. Rubber coating on lines
   d. Braided plastic lines

3. When opening and closing service valves, what tool do you use?

   a. A special ratchet wrench
   b. Channel lock pliers
   c. Cresent wrench
   d. Water pump pliers

4. What is the purpose of interior fans on display cases?

   a. To circulate defrost air
   b. To keep flies off the display case
   c. To circulate air
   d. Remove odor from display case

5. When charging a sealed system, after hooking up manifold gauges, what must you do?

   a. Invert refrigerant bottle
   b. Bleed hoses
   c. Check for acid system
   d. Remove head pressure

6. Where are thermostat expansion valves located in a display case?

   a. In the evaporator compartment
   b. In the condenser compartment
   c. In the compressor compartment
   d. Underneath the unit near the drain

7. What controls the defrost cycle of a display case?

   a. Defrost timer
   b. Defrost bimetal
   c. High pressure overload switch
   d. Low pressure overload switch

File Code: 751.02.09.03

Date Published: 11/10/77

Family Education Program

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: ICE MAKERS

INTRODUCTION:

This LAP covers typical ice makers used in various commercial applications. The prerequisite is to have read and completed the previous LAPS successfully.

REVIEW:

There are several types of ice makers used in commercial establishments to produce large quantities of ice. Ice can be produced in many shapes and sizes. These systems produce the same result using different components and operations.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain the cycle of a typical ice maker.
2. Troubleshoot the system using appropriate test equipment.
3. Replace defective components.

ASSIGNMENT:

Study Chapter 14 in Modern Refrigeration and Air Conditioning, covering commercial ice makers. Go over experiment 16 in your lab manual.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

None.

PERFORMANCE:

Perform experiment 16 in your lab manual on the trainer. After you have completed experiment 16, notify your instructor. Your instructor will explain what work he wants you to do on the Frigidaire ice maker in the shop. While working on the trainer, be careful and ask for help when needed.

Principal Author(s): John Carey

Family Training Center, Inc.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor go over your Performance Test. All items must be accomplished successfully as assessed by your instructor.

SUMMARY:

Have your instructor go over your test with you. You should now understand the following:

1. How an ice maker works.
2. What components are used in various cycles.
3. Repair procedure.

After successful completion, record LAP on SPR, notify your instructor when you are ready to take the Unit Performance and Written Test.

Student: ____________________ File Code: 751.02.09.03

Date: ____________________ Date Published: 12-13-77

Family
Education
Program

LAP TEST: ICE MAKERS

1. Name two types of commercial ice makers.

   a. Cube, flake
   b. Rounding cube
   c. Flake and crushed
   d. Crushed and round

2. What controls the water flow in an ice maker?

   a. Floats and solenoids
   b. Floats and valve switches
   c. Valve switches and water pressure dispensers
   d. Water release valve and floats

3. On an ice cube maker what releases a slab of ice off the evaporator?

   a. Hot water from a boiler
   b. Hot condenser gas
   c. Heaters that are energized
   d. From a salt mixer sprayed on the slab

4. What cuts the slab up in an ice maker?

   a. Electrical grids
   b. Solenoid cutter
   c. Ice chisels
   d. Sharp hydrologic knives

5. What circulates the water in the system?

   a. Sump pump
   b. Circulatory valve
   c. Water pressure
   d. Gravity

Student: ______________________ File Code: 751.02.09.00

Date: ______________________ Date Published: 2-20-78

Family Education Program

UNIT TEST: COMMERCIAL SYSTEMS

75.02.09.01

1. Where is the evaporator located in a walk-in cooler?

   a. on the of the unit.
   b. along side the unit.
   c. inside the walk-in cooler.
   d. under the walk-in cooler.

2. When a service valve is screwed all the way in, will refrigerant flow through the system?

   a. no.
   b. yes.
   c. only on a Frigidaire system.
   d. depends on what refrigerant is being used.

3. In which position should the valve be turned when obtaining access to the service port?

   a. all the way in.
   b. all the way out.
   c. it doesn't matter.
   d. 3/4 of a turn in.

4. What should be installed on a liquid line on a walk-in cooler to check refrigerant level and if any moisture is present?

   a. refrigerant level switch.
   b. high pressure refrigerant switch.
   c. a sight glass moisture indicator.
   d. moisture indicator and refrigerant level switch.

5. What is used to absorb moisture and any foreign particles in a refrigeration system?

   a. an accumulator.
   b. a receiver.
   c. the evaporator.
   d. a filter dryer.

6. In a double evaporator system, what is used to control the amount of refrigerant flowing into the evaporator?

   a. thermostat expansion valve.
   b. suction release valve.
   c. high side release valve.
   d. a suction metering valve.

75.02.09.01 (continued)

7. What controls the amount of water flowing through a water cooled condenser?

   a. water pressure switch.
   b. globe valve.
   c. gate valve.
   d. water operated low pressure solenoid valve.

8. What do you check for current draw on a system?

   a. voltmeter.
   b. amp meter.
   c. capacitor analyzer.
   d. resistance meter.

9. What do you use to check for acid content in a sealed system?

   a. acid test kit.
   b. pressure drop across the filter.
   c. acid analyzer.
   d. paint discoloration of sight glass.

10. In most systems what does the thermostat cycle?

   a. the compressor.
   b. solenoid.
   c. defrost timer.
   d. the high pressure switch.

75.02.09.02

11. On a self-contained display case, where is the compressor located?

   a. in an adjoining room.
   b. in the basement below the unit.
   c. in the display case underneath.
   d. in the evaporator compartment.

12. What is used to prevent vibration of the lines in a refrigeration system?

   a. flexible tubing.
   b. lines mounted on springs.
   c. rubber coating on lines.
   d. braided plastic lines.

13. When charging a sealed system, after hooking up manifold gauges, what must you do?

   a. invert refrigerant bottle.
   b. bleed hoses.
   c. check for acid system.
   d. remove head pressure.

75.02.09.02 (continued)

14. Where are thermostat expansion valves located in a display case?

    a. in the evaporator compartment.
    b. in the condenser compartment.
    c. in the compressor compartment.
    d. underneath the unit near the drain.

15. What controls the defrost cycle of a display case?

    a. defrost timer.
    b. defrost bi-metal.
    c. high pressure overload switch.
    d. low pressure overload switch.

75.02.09.03

16. Name two types of commercial ice makers?

    a. cube, flake.
    b. round, cube.
    c. flake and crushed.
    d. crushed and round.

17. What controls the water flow in an ice maker?

    a. floats and solenoids.
    b. floats and valve switches.
    c. valve switches and water pressure dispensers.
    d. water release valve and floats.

18. On an ice cube maker, what releases a slab of ice off the evaporator?

    a. hot water from a boiler.
    b. hot condensor gas.
    c. heaters that are energized.
    d. from a salt mixer sprayed on the slab.

19. What cuts the slab off in an ice cube maker?

    a. electrical grids.
    b. solenoid cutter.
    c. ice chisels.
    d. shape hydrologic knives.

20. What circulates the water in the system?

    a. sun pump.
    b. circulatory valve.
    c. water pressure.
    d. gravity.

Student: ____________________ File Code: 751.02.09.00

Date: ____________________ Date Published: 1-27-78

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

UNIT PERFORMANCE TEST: COMMERCIAL SYSTEMS

OBJECTIVE 1:

Using appropriate tools, equipment, supplies, and procedures, troubleshoot, repair, and service a residential central cooling system.

TASK:

Given a residential central cooling system, that is inoperable, the student must troubleshoot, repair and service the system, using appropriate tools, equipment, supplies, and repair procedures.

ASSIGNMENT:

CONDITIONS:

The troubleshooting, repair and service of a residential central comfort cooling system will be accomplished on a real system. He will be allowed to use all the equipment, tools, and resource materials commonly found in a typical repair shop. The student will not be allowed to obtain any assistance from the instructor or other students. The job must be completed within the time indicated.

RESOURCES:

Printed Material:

Modern Refrigeration and Air Conditioning, Althouse

Equipment:

one central air conditioner installed in furnace.

RESOURCES: (Cont.)

Tools:
1 1/4" ratchet wrench
1 Set open end wrenches
1 8" adj. wrench
1 Spout can of oil
1 Pair safety goggles
1 6" screwdriver - 1/4" blade
1 #2 Phillips screwdriver
1 Set of valve adapters

Instruments:
1 Gauge manifold, complete
1 Thermometer
1 Vacuum pump
1 Electrical analyzer

Supplies:
1 Wiping cloth
1 1 to 5 lb. refrigerant service cylinder

ASSIGNMENT SHEET

OBJECTIVE 1:

1. Test external circuit first: Power in, thermostat, relay, capacitor, overload protector, motor compressor, filter, air flow, condensate drain, fresh air supply, and condenser cooling medium.
2. Install gauges, check pressures, and test for leaks.
3. Run the unit for at least fifteen minutes. Check the TEV operation, condenser condition, fans and motors and temperatures.
4. If the unit is frosting, the TEV may be leaking, the thermostat is not shutting off, or the TEV bulb is loose.
5. If the coil is starved, the valve may be partially clogged with moisture, or dirt, or the screen may be partially clogged, or there may be a lack of refrigerant.
6. Repair what is necessary. Remove the refrigerant from the part to be repaired. BE CAREFUL! Replace the worn part and assemble the unit. Evacuate the air, charge, and test for leaks.

	At the Beginning	After 15 Minutes	After Repair
Low Side Pressure			
High Side Pressure			
Suction Line Temp., Approx.			
Liquid Line Temp., Approx.			
Evaporator Temperature			
Noise, Compressor			
Motor			

Remarks:

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

Student: ______________________ **File Code:** 751.02.09.00

Date: ______________________ **Date Published:** 11/15/74

FAMILY PAY NUMBER:__________ SEX: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory_____ Unsatisfactory_____

	CRITERION	
	Met	Not Met
Objective 1:		
1. Properly corrects all electrical malfunctions:		
(thermostat, relay, capacitor overload protector,		
motor compressor, etc.)		
Criterion: Electrical system functions according to the		
manufacturer's specifications.		
2. Installs gauges properly.		
Criterion: Modern Refrigeration and Air Conditioning,		
paragraph 12-17.		
3. Accurately checks and records pressures.		
Criterion: System pressures compare to the manufacturer's		
specifications.		
4. Accurately takes and records temperatures.		
Criterion: Recorded temperatures compare to the		
manufacturer's specifications.		

(Checklist continued)

	CRITERION Met	Not Met
5. When applicable, student correctly services and repairs TEV valve (Thermostatic Expansion Valve).		
Criterion: Valve operates according to the manufacturer's specifications.		
6. Uses appropriate tools, equipment, and procedures.		
Criterion: System operates according to specifications.		
7. Follows appropriate safety practices and procedures.		
Criterion: Complies with OSHA regulations and no injury results.		
8. Work is neat and presentable.		
Criterion: No visible damage results to the equipment and assembled parts are installed to manufacturer's specifications.		
9. All mechanical fastenings are correct.		
Criterion: System is assembled to manufacturer's specifications.		
10. All data is filled out on the Assignment Sheet.		
Criterion: Assignment Sheet and no data is missing.		
11. Gas is installed properly if needed.		
Criterion: System functions to the manufacturer's specifications.		
12. The job is completed in a reasonable time.		

(Checklist continued)

	CRITERION Met	 Not Met
Criterion: Not to exceed 8 hours.		
The student must complete all of the line items to pass this test.		

LAP TEST ANSWER KEY: WALK-IN COOLER

1. c
2. a
3. a
4. a
5. c
6. d
7. a
8. a
9. a
10. c
11. b
12. a
13. b

LAP TEST ANSWER KEY: DISPLAY CASES

1. c
2. a
3. a
4. c
5. b
6. a
7. a

UNIT TEST ANSWER KEY: COMMERCIAL SYSTEMS

LAP 01

1. C
2. A
3. A
4. C
5. D
6. A
7. A
8. B
9. A
10. B

LAP 02

11. C
12. A
13. B
14. A
15. A

LAP 03

16. A
17. A
18. B
19. A
20. A

LAP TEST ANSWER KEY: ICE MAKER

1. a
2. a
3. b
4. a
5. a

File Code: 751.02.10.01

Date Published: 11/10/77

Family Education Program

Learning Activity Package

Student: __________

Date: __________

PERFORMANCE ACTIVITY: ELECTRIC AIR CLEANER

INTRODUCTION:

This LAP covers the electric air cleaner used in domestic furnace installation. The prerequisite is to have read and completed successfully the previous units.

REVIEW:

A total comfort house has the air filtered. The most efficient way, giving the best results, is with an electronic air cleaner. An air cleaner not only cleans the air, but filters out germs and particles that may affect a person with an allergy or hay fever. They can be used as a tax write-off if prescribed by a doctor. For these reasons many thousands of units are out, and they all need service and maintenance.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain how an electronic air cleaner operates.
2. Replace defective components.
3. Install an air cleaner.

ASSIGNMENT:

Study Chapter 22 in Modern Refrigeration and Air Conditioning, covering electronic air cleaning and air movement.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

Have your instructor demonstrate the electronic air cleaner for you. If you have any questions ask your instructor before proceeding.

Principal Author(s): John Carey

PERFORMANCE:

Disassemble the unit into the five (5) parts:

1. central panel
2. housing
3. grid
4. grid wire
5. filters

Reassemble when you have your instructor's approval. Operate the unit, make sure it is working properly. CAUTION!!!! Be sure power is off before working on the unit.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor check over your Performance work. All items must be accomplished successfully as assessed by your instructor.

SUMMARY:

Have your instructor go over your test. You should now understand the following:

1. How an electronic air cleaner works.
2. How to service.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ____________________ **File Code:** 751.02.10.01

Date: ____________________ **Date Published:** 12-13-77

Family Education Program

LAP TEST: ELECTRONIC AIR CLEANING

1. What type of voltage is the air passed through in an electronic air cleaner?

   a. High voltage
   b. Low voltage
   c. Resistance voltage
   d. Direct voltage

2. How do you clean the air filters in an electronic air cleaner?

   a. Warm soapy water
   b. A chemical solution
   c. Using the vacuum cleaner
   d. Using a steel brush, a wire brush and a scraper

3. What is used to increase your voltage in the system?

   a. Voltage rectifier
   b. Transformer
   c. Voltage increase resistant
   d. Energizer

4. At what approximate voltage does electronic air cleaner operate at?

   a. 4.000 volts
   b. 6,000 volts
   c. 24,000 volts
   d. 12,000 volts

5. Will electronic air cleaner remove odors from the area?

   a. Yes
   b. No
   c. Some of the odors
   d. 2% of the odors

6. How are particles collected on the plates?

   a. The dirt particles pass through an ionized field
   b. The dirt is attracted to the magnesium plates
   c. The dust is attracted by a magnetic force
   d. The dust particles are absorbed by the nitrogen content of the aluminum plates

File Code: 751.02.10.02

Date Published: 11/10/77

Family Education Program

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: HUMIDIFYING

INTRODUCTION:

This LAP covers domestic furnace humidifiers used in the typical home. The prerequisite is to have read and completed the previous LAP successfully.

REVIEW:

In many parts of the country the relative humidity is very low. This will dry out a house, ruin furniture and affects some people's health and well being. There are thousands of humidifiers in use today, all need service and maintenance sooner or later.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Identify electrical components on a humidifier.
2. Check and replace defective components.
3. Install a humidifier according to manufacturer's specifications.

ASSIGNMENT:

Study Chapter 20 in Modern Refrigeration and Air Conditioning, covering humidifying.

WRITTEN EVALUATION:

When you have completed the assignment, take the test. Upon successful completion, continue.

DEMONSTRATION:

Have your instructor demonstrate the furnace humidifier trainer.

PERFORMANCE:

Shut power off to the trainer. Disassemble the humidifier, with your instructor's permission, reassemble it.

Principal Author(s): John Carey

Family Training Center, Inc.

PERFORMANCE EVALUATION:

Tell your instructor when you are ready to take the Performance Test. Have your instructor check over your Performance work. All items must be accomplished successfully.

SUMMARY:

Have your instructor go over your test. You should now understand the following:

1. What a humidifier does.
2. How it operates.
3. How to repair or replace defective units.

After successful completion, record LAP on SPR and proceed to the next LAP.

SUMMARY:

Have your instructor go over your test. You should now understand the following:

1. What solar heating is.
2. How solar heating operates.

After successful completion, record LAP on SPR and prepare for the Unit Performance and Written Test.

File Code: 751.02.10.03

Date Published: 11/10/77

Family Education Program

Learning Activity Package

Student: ________________

Date: ________________

PERFORMANCE ACTIVITY: SOLAR HEATING

INTRODUCTION:

This LAP covers solar heating. The prerequisite is to have read and completed successfully the previous LAP.

REVIEW:

With the rising cost of fuel, people are turning to the sun for energy to heat their homes. It isn't a new idea, but technology is advancing to the point where solar heat may be an efficient way to heat a home. A technician should be aware of solar power and how it operates.

COMPETENCY:

Upon successful completion of this LAP, you will be able to do the following:

1. Explain how a typical solar system works.
2. Answer test questions correctly.

ASSIGNMENT:

Study the chapter in Modern Refrigeration and Air Conditioning, covering solar heating.

WRITTEN EVALUATION:

When you have completed the assignment, take the test.

DEMONSTRATION:

None.

PERFORMANCE:

None.

PERFORMANCE EVALUATION:

Ask your instructor if there is a Performance Evaluation.

Principal Author(s): John Carey

Student: ______________________ **File Code:** 751.02.10.00

Date: ______________________ **Date Published:** 2-20-78

Family Education Program

UNIT TEST: OTHER AIR CONDITIONING SYSTEMS

75.02.10.01

1. What type of voltage is the air passed through in an electronic air cleaner?

   a. high voltage.
   b. low voltage.
   c. resistance voltage.
   d. direct voltage.

2. How do you clean the air filters in an electronic air cleaner?

   a. warm soapy water.
   b. a chemical solution.
   c. using the vacuum cleaner.
   d. using a steel brush, a wire brush, and a scrapper.

3. At what approximate voltage does electronic air cleaner operate at?

   a. 4,000 volts.
   b. 6,000 volts.
   c. 24,000 volts.
   d. 12,000 volts.

4. Will electronic air cleaner remove odors from the area?

   a. yes.
   b. no.
   c. some of the odors.
   d. 2% of the odors.

5. How are particles collected on the plates?

   a. the dirt particles pass through an inonized field.
   b. the dirt is attracted to the magnesium plates.
   c. the dust is attracted by a magnetic force.
   d. the dust particles are absorbed by the nitrogen content of the aluminum plates.

75.02.10.02

6. What is the purpose of a humidifier?

   a. take moisture out of the air.
   b. put moisture into the air.
   c.. clean the air.
   d. humidify the oxygen in the air.

75.02.10.02 (continued)

7. What is a media pad used for in a humidifier?
   - a. absorb and transport moisture.
   - b. prevent vibration in the humidifier.
   - c. keep the humidifier from over heating.
   - d. catch over flowing water.

8. When mounting a furnace humidifier you should make sure the unit is:
   - a. level.
   - b. secure with rubber mounts.
   - c. in a well ventilated area.
   - d. installed on a cold air return of the heat system.

Student: ____________________ File Code: 751.02.10.02/.03

Date: ____________________ Date Published: 12-13-77

LAP TEST: HUMIDIFYING

1. What is the purpose of a humidifier?
   - a. Take moisture out of the air
   - b. Put moisture into the air
   - c. Clean the air
   - d. Humidify the oxygen in the air
2. What is a media pad used for in a humidifier?
   - a. Absorb and transport moisture
   - b. Prevent vibration in the humidifier
   - c. Keep the humidifier from over heating
   - d. Catch over flowing water
3. When mounting a furnace humidifier you should make sure the unit is
   - a. Level
   - b. Secure with rubber mounts
   - c. In a well ventilated area
   - d. Installed on a cold air return of the heat system
4. What senses how much humidity is in the air?
   - a. Thermostat
   - b. Low pressure switch
   - c. Humidistat
   - d. Air flow switch
5. Does the temperature of a room affect the humidity?
   - a. No
   - b. Yes
   - c. Sometimes
   - d. None of the above
6. What controls the amount of water coming into a humidifier?
   - a. Float valve
   - b. Float relay
   - c. Filter regulator
   - d. Over flow switch

LAP TEST ANSWER KEY: ELECTRIC AIR CLEANING

1. a
2. a
3. b
4. d
5. c
6. a

LAP TEST ANSWER KEY: HUMIDIFYING AND SOLAR

1. b
2. a
3. a
4. c
5. b
6. a

UNIT TEST ANSWER KEY: OTHER AIR CONDITIONING SYSTEMS

LAP 01

1. A
2. A
3. D
4. C
5. A

LAP 02

6. B
7. A
8. A

Family Education Program

File Code: 751.02.11.01

Date Published: 11/17/77

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: BASIC INSTALLATIONS

INTRODUCTION:

This LAP covers the installation of heating, cooling, humidifying and filtering equipment. The only prerequisite is to have read and completed successfully the previous units.

REVIEW:

If a service technician is to be competent in his job and has full understanding of how systems work, he must know how the system is correctly installed. When doing service calls you will find that a majority of problems arise from faulty installations.

COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Explain how heating, cooling, humidifying, and filtering equipment should be installed correctly.
2. Be able to identify various components on the systems.
3. Correct any faulty installation.

ASSIGNMENT:

Read chapter 1 though 3,4, and 5. Introduction to the Installation of Residential Duct Heating and Air Conditioning System, written by National Environmental Systems Contractors Association.

WRITTEN EVALUATION:

When you have completed the assignment, take the test.

DEMONSTRATION:

None.

PERFORMANCE:

None.

Principal Author(s):

Family Training Center, Inc.

PERFORMANCE EVALUATION:

There is no Performance Test for this LAP. Have your instructor go over any questions that you may have. All items must be accomplished successfully as assessed by your instructor.

SUMMARY:

Have your instructor go over the test with you. You should now understand the following:

1. How heat, cooling, humidifying and filtering equipment is installed.
2. How to correct faulty installations.
3. Why the equipment is used and proper installation.

After successful completion, record the LAP on your SPR and proceed to the next LAP.

Student: ______________________ **File Code:** 751.02.11.01

Date: ______________________ **Date Published:** 12/12/77

Family Education Program

LAP TEST: BASIC INSTALLATIONS

1. Name three (3) models of forced air furnaces:

   a. upflow, downflow, crossflow.
   b. downflow, horizontal flow, reverse flow.
   c. upflow, downflow, horizontal flow
   d. crossflow, reverse flow, downflow.

2. On an upflow furnance, where is the blower located?

   a. below the heat exchanger.
   b. above the heat exchanger.
   c. along side the heat exchanger.
   d. along side the gas valve.

3. Where is the humidifier installed?

   a. cold air return.
   b. warm air plenium.
   c. under heat exchanger.
   d. over return grill.

4. Name the coil that isn't used in a typical central air:

   a. a coil.
   b. flat coil.
   c. slant coil.
   d. round coil.

5. Where is a furnace filter located?

   a. blower housing.
   b. heat exchanger.
   c. warm air plenium.
   d. under blower control.

File Code: 751.02.11.02

Date Published: 11/21/77

Family Education Program

Learning Activity Package

Student:

Date:

PERFORMANCE ACTIVITY: READING PLANS AND TYPES OF INSTALLATION

INTRODUCTION:

This LAP covers how to read a plan, and various types of duct systems and components used. The prequisite is to have read and completed successfully the previous LAPS.

REVIEW:

When installing a heat system the installer must have some sort of plan or idea of how he will install the system in the house. To do this, a service technician must know how to read blueprints. He must also know the various types of duct systems and vent systems and how they are installed.

COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Read a blueprint accurately.
2. Identify or describe the various types of installations.
3. Identify or recognize an incorrect installation.
4. Describe how an incorrect installation should be corrected.

ASSIGNMENT:

Read Chapter 7,8,9 and 10 in Introduction to the Installation of Residential Duct Heating and Air Conditioning System, written by NESCA.

WRITTEN EVALUATION:

When you have completed the assignment, take the test.

DEMONSTRATION:

None.

PERFORMANCE:

None.

Principal Author(s): John Carey

Family Training Center, Inc.

PERFORMANCE EVALUATION:

There is no Performance Test for this LAP.

SUMMARY:

Have your instructor go over the test with you. You should now understand the following:

1. How to read a blueprint.
2. How to install various types of duct and vent systems.
3. Be able to determine a faulty installation from a good installation.

After successful completion, record LAP on SPR and proceed to the next LAP.

Student: ______________________ **File Code:** 751.02.11.02

Date: ______________________ **Date Published:** 12/12/77

Family Education Program

LAP TEST: READING PLANS AND TYPES OF INSTALLATIONS

1. Architectural drawings are prepared:

   a. symbolically.
   b. carefully.
   c. rapidly.
   d. systematically.

2. What is a means of reducing a building dimension:

   a. shortening dimension.
   b. rounding it off to the lowest #.
   c. drawing it to scale.
   d. shrinking.

3. When is an extended plenium system used?

   a. single story.
   b. two story.
   c. brick houses.
   d. wood houses.

4. When installing a heating cooling system in a crawl space, what must be done to runs?

   a. insulated.
   b. waterproofed
   c. duffusers used.
   d. extra runs added.

5. When is a flat coin used?

   a. with horizontal furnace.
   b. with upflow furnace.
   c. with counterflow furnace.
   d. with crossflow furnace.

Family Education Program

File Code: 751.02.11.03

Date Published: 11/21/77

Learning Activity Package

Student:

Date:

PERFORMANCE ACTIVITY: CODES AND STANDARDS

INTRODUCTION:

This LAP covers various codes and standards used in the heating industry. This LAP will also cover electrical safety and customer relations. The prerequisite is to have read and successfully completed the previous LAPS.

REVIEW:

With the increase of technology and the rapid change in the heating and air conditioning industry, there is a growing concern for safety and standards. A service technician must know the correct way of installing systems so that they are safe and conform to local and state codes. One incorrect installation can cause a contractor to lose valuable time and money not to mention his license. As in any other job, an employee must do safe efficient, reliable work.

COMPETENCY:

Upon successful completion of this LAP you will be able to do the following:

1. Explain and understand different codes and standards used in the industry.
2. Be able to work in a safe productive manner.
3. Understand your obligations to the customer and to your employer.

ASSIGNMENT:

Read Chapters 21,22,23,24, and 25 in Introduction to the Installation of Residential Duct Heating and Air Conditioning Systems, published by NESCA.

DEMONSTRATION:

None.

PERFORMANCE:

None.

Principal Author(s): John Carey

PERFORMANCE EVALUATION:

There is no Performance Test for this LAP.

SUMMARY:

Have your instructor go over the test with you. You should now understand the following:

1. Why codes and standards are needed.
2. What customers and employers expect of you and how to deal with them.
3. What safety steps are taken.

After successful completion, record LAP on SPR and prepare for the Unit Written Test. Notify your instructor when you feel you are ready to take the Written Test.

Student: ____________________ File Code: 751.02.11.03

Date: ____________________ Date Published: 12/12/77

Family Education Program

LAP TEST: CODES AND STANDARDS

1. What is the brain center of an air conditioning system?

    a. electrical components.
    b. plenium.
    c. thermostat.
    d. relay.

2. How many volts are run to condensing unit on a typical system?

    a. 110.
    b. 208.
    c. 440.
    c. 38.

3. How many volts are run to furnace:

    a. 110.
    b. 208.
    c. 440.
    d. 38.

4. What agency checks businesses for safe working conditions:

    a. U.L.
    b. OSHA.
    c. ARI.
    d. AGA.

5. When using a power tool, you should make sure it is:

    a. high quality.
    b. plugged in.
    c. rotating properly.
    d. grounded.

6. What do you wear when soldering, brazing and drilling?

    a. safety goggles.
    b. long sleeve shirt.
    c. steel tipped boots.
    d. gloves.

7. When you notice an unsafe condition you:

   a. avoid it.
   b. put up a warning sign.
   c. inform supervisor.
   d. forget about it.

8. Who sets standard for rating air conditioning equipment?

   a. ARI.
   b. AGA.
   c. UL.
   d. NFPA.

9. Who sets standards for electrical wiring?

   a. ARI.
   b. AGA.
   c. UL.
   d. NEC.

10. When dealing with a customer, what should be your guide?

    a. basic common sense.
    b. money involved.
    c. P.R. rule.
    d. standard operating procedures.

Student: ____________________ File Code: 751.02.11.00

Date: ____________________ Date Published: 2-20-78

Family Education Program

UNIT TEST: EQUIPMENT INSTALLATIONS

75.02.11.01

1. Name three (3) models of forced air furnaces:

   a. upflow, downflow, crossflow.
   b. downflow, horizontal flow, reverse flow.
   c. upflow, downflow, horizontal flow.
   d. crossflow, reverse flow, downflow.

2. On an upflow furnace, where is the blower located?

   a. below the heat exchanger.
   b. above the heat exchanger.
   c. along side the heat exchanger.
   d. along side the gas valve.

3. Where is the humidifier installed?

   a. cold air return.
   b. warm air plenium.
   c. under heat exchanger.
   d. over return grill.

4. Name the coil that isn't used in a typical central air:

   a. a coil.
   b. flat coil.
   c. slant coil.
   d. round coil.

5. Where is a furnace filter located?

   a. blower housing.
   b. heat exchanger.
   c. warm air plenium.
   d. under blower control.

75.02.11.02

6. Architectural drawings are prepared:

   a. symbolically.
   b. carefully.
   c. rapidly.
   d. systematically.

75.02.11.02 (continued)

7. What is a means of reducing a building dimension:

   a. shortening dimension.
   b. rounding it off to the lowest #.
   c. drawing it to scale.
   d. shrinking.

8. When is an extended plenium system used?

   a. single story.
   b. two story.
   c. brick houses.
   d. wood houses.

9. When installing a heating cooling system in a crawl space, what must be done to runs?

   a. insulated.
   b. waterproofed.
   c. duffusers used.
   d. extra runs added.

10. When is a flat coin used?

    a. with horizontal furnace.
    b. with upflow furnace.
    c. with counterflow furnace.
    d. with crossflow furnace.

75.02.11.03

11. How many volts are run to condensing unit on a typical system?

    a. 110
    b. 208.
    c. 440
    d. 38

12. What agency checks businesses for safe working conditions:

    a. U.L.
    b. OSHA
    c. AEI
    d. AGA

13. What do you wear when soldering, brazing and drilling?

    a. safety goggles.
    b. long sleeve shirt.
    c. steel tipped boots.
    d. gloves.

75.02.11.03 (continued)

14. When you notice an unsafe condition you:

    a. avoid it.
    b. put up a warning sign.
    c. inform supervisor.
    d. forget about it.

15. When dealing with a customer, what should be your guide?

    a. basic common sense.
    b. money involved.
    c. P.R. rule.
    d. standard operating procedures.

LAP TEST ANSWER KEY: BASIC INSTALLATION

1. c
2. a
3. b
4. d
5. a

LAP TEST ANSWER KEY: READING PLANS AND TYPES OF INSTALLATIONS

1. a
2. c
3. b
4. a
5. a

LAP TEST ANSWER KEY: CODES AND STANDARDS

1. a
2. b
3. a
4. b
5. d
6. a
7. c
8. a
9. d
10. a

UNIT TEST ANSWER KEY: EQUIPMENT INSTALLATIONS

LAP 01

1. C
2. A
3. B
4. D
5. A

LAP 02

6. A
7. C
8. B
9. A
10. A

LAP 03

11. B
12. B
13. A
14. C
15. A